DIGITAL COMPUTER NEWSLETTER

The purpose of this newsletter is to provide a medium for the interchange among interested persons of information concerning recent developments in various digital computer projects. Distribution is limited to government agencies, contractors, and contributors.

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Editorial Policy Notices

EDITORIAL

The Digital Computer Newsletter, although a Department of the Navy publication, is not restricted to the publication of Navy-originated material. The Office of Naval Research welcomes contributions to the Newsletter from any source. The Newsletter is subject to certain limitations in size which prevent publishing all the material received. However, items which are not printed are kept on file and are made available to interested personnel within the Government.

DCN is published quarterly (January, April, July, and October). Material for specific issues must be received by the editor at least three months in advance.

It is to be noted that the publication of information pertaining to commercial products does not, in any way, imply Navy approval of those products, nor does it mean that Navy vouches for the accuracy of the statements made by the various contributors. The information contained herein is to be considered only as being representative of the state-of-the-art and not as the sole product or technique available.

CONTRIBUTIONS

The Office of Naval Research welcomes contributions to the Newsletter from any source. Your contributions will provide assistance in improving the contents of the publication, thereby making it an even better medium for the exchange of information between government laboratories, academic institutions, and industry. It is hoped that the readers will participate to an even greater extent than in the past in transmitting technical material and suggestions to the editor for future issues. Material for specific issues must be received by the editor at least three months in advance. It is often impossible for the editor, because of limited time and personnel, to acknowledge individually all material received.

CIRCULATION

The Newsletter is distributed, without charge, to interested military and government agencies, to contractors for the Federal Government, and to contributors of material for publication.

For many years, in addition to the ONR initial distribution, the Newsletter was reprinted by the Association for Computing Machinery as a supplement to their Journal and, more recently, as a supplement to their Communications. The Association decided that their Communications could better serve its members by concentrating on ACM editorial material. Accordingly, effective with the combined January-April 1961 issue, the Newsletter became available only by direct distribution from the Office of Naval Research.

Requests to receive the Newsletter regularly should be submitted to the editor. Contractors of the Federal Government should reference applicable contracts in their requests.

All communications pertaining to the Newsletter should be addressed to:

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Computers and Data Processors, North America

ILLIAC IV

University of Illinois
Urbana, Illinois

An electronic computer which may be up to 50 times faster than any other now contemplated is planned at the University of Illinois at Urbana.

The university's board of trustees has authorized execution of a contract for more than $8 million from the Department of Defense through the Air Force Rome Air Development Center at Griffiss Air Force Base, N.Y.

Completion of negotiations involves approval of the univeristy, Illinois State Board of Higher Education, Rome Air Development Center, and Advanced Research Projects Agency of the Department of Defense.

The project is planned as a joint effort between the University of Illinois and industry. The machine has been labeled "Illiac IV" as fourth in the series of pioneering electronic computers designed and built at Illinois.

Prof. John R. Pasta, head of the department of computer science in the university's Graduate College, said that $6 million is budgeted for construction, to be completed in 2-1/2 years, and $1 million for operation in each of the following 2 years.

Illiac IV will pioneer a new concept in special purpose computer organization developed by Prof. Daniel L. Slotnick, who will be in charge of the project. The machine is planned for upwards of 1 billion computations a second.

To achieve this speed, Illiac IV will have one control unit with a very large number of linked arithmetic and data storage units. Slotnick said that initially several hundred units will be operated, but this number can be increased virtually without limit.

He explained that present computer development has nearly reached limits set by complexity, cost, and the maximum speed with which electricity can move. Illiac IV will avoid these limitations through its organization, described as "large scale, highly parallel."

The fastest computer now being built will be capable of 8 million computations a second, achieved by linking a number of computers together, and the foreseeable limit for machines of this type, he said, is probably 40 million computations a second. Possibilities of the new computer are staggering.

In weather forecasting, for example, accurate forecasts through use of computers are possible, but with present computers a good 48-hour forecast requires 52 hours of computer time. With Illiac IV this time will be greatly reduced.

Similarly in defense, radar is capable of providing more precise counter-missile data than now can be used. Vitally important are the most accurate data and computations possible to intercept an approaching missile, but the information must be available and usable before that missile arrives.

In bioelectronics, the neuron network of the brain is under study. To explore directly the complex electronic net of an actual brain is impossible; to study this, scientists want to reproduce the net or a part of it with an electronic computer. None today is extensive enough. Illiac IV will be.

Radio astronomers, sweeping the cosmos with their telescopes, gather new and often strange information in vast quantities. This is understandable and important only when analyzed through vast and complex mathematics, for which Illiac IV will be capable.

The National Center for Atmospheric Research, Department of Defense, and others will have men at the university during development and construction of Illiac IV. When the project is completed, they will have the information and experience to build and use similar computers elsewhere.

Design of the computer will be a joint effort involving the university, other potential users,

and industry. Eight months have been assigned to this planning phase. In the following 2 years, Illiac IV will be assembled and installed at the university with parts commercially produced by industry.

Final phase of the project, application, will involve the system in the broadest possible range of uses–academic, industrial, and governmental –and with a visiting scientist program of international scope.

Illiac IV will be used both directly and through the university's computing center, which has many high-speed devices and is developing a system of remote consoles providing access to its facilities from various parts of the campus.

Slotnick, who joined the University of Illinois faculty in 1965, was in 1962 winner of the first American Federation of Information Processing Societies prize for an outstanding technical paper in this field.

He earned his bachelor's degree from Columbia College, master's from Columbia University, and doctorate in applied mathematics from New York University Institute of Mathematical Sciences.

He was at the Institute for Advanced Study at Princeton during 1952-54 when Prof. John von Neumann was doing the world's pioneering in electronic computers. From 1957-60 he was with International Business Machines Corp. and 1960-65 with Westinghouse Electric Corp.

Illiac I, built at Illinois in 1952, had 2,800 vacuum tubes. It has been retired. Illiac II, completely transistorized, began operation in 1962. Illiac III, a pattern recognition computer of great speed, is under construction.

Computing Centers

Remote Computer Network

State of California Department of Public Works
Sacramento, California

Highway engineers throughout the State of California, from San Diego to Eureka, now have a direct line to a powerful new IBM computer here in Sacramento.

In May, state highway engineer, Mr. J.C. Womack, said the new computer, an IBM System/360, is now operational and is processing both fiscal data and engineering computations. It is to become the hub of a statewide system designed to meet all of the Division's data processing needs.

Mr. Womack said that Division of Highway district offices located in 11 different cities are being linked by conventional telephone lines directly to the computer. "Each office will be equipped with a data transmission terminal to enable engineers and administrative people to communicate with the central computer," he said.

At present, when a district needs the assistance of a Sacramento computer in solving an engineering problem, the data are normally transmitted either by bus or mail. The new network, when it becomes fully operational by the end of 1966, should save much of the time now spent in getting problems to, and answers from, the computer.

Some of the presently computerized engineering functions which will be transferred to the Division's new network are: highway geometric or traverse computations; computing quantities of steel or concrete needed for abutments and overcrossings; estimating quantities of earthwork to be moved; and statistical analyses of alternate freeway routings.

The new computer will assist State officials in the many management decisions that are required in keeping pace with constantly changing highway requirements.

District offices scheduled to receive communications terminals are San Diego, San Bernardino, Los Angeles, San Luis Obispo, Fresno, Bishop, Marysville, San Francisco, Eureka, Redding, and Stockton.

Multiple IBM 360 Installation

Willis H. Booth Computing Center
California Institute of Technology
Pasadena, California 91109

The Willis H. Booth Computing Center at the California Institute of Technology has started the installation of its second multiple computer information processing system to serve the Institute's needs in basic research and education. The present IBM 7094 and Burroughs 220, plus a variety of remote consoles and other devices, is being replaced by three IBM 360 computers and other smaller data processors. An IBM 360/50, now in operation, will serve as the community monitor for this system and provides the principal mode of interaction with students in formal course work. In this capacity it provides a conventional language system for a large number of remote typewriter consoles.

Data Processing Center

Cleveland Board of Education
Cleveland, Ohio

The Cleveland Board of Education has ordered a new computer to help relieve the school system's 5,600 teachers of much of their burdensome paperwork and to modernize business operations, according to Supt. Paul W. Briggs.

The IBM System/360 Model 30 will be used to automate all record keeping and scheduling tasks and its installation later this year is considered to be a major step in the Board's modernization and administrative reorganization program, Supt. Briggs said.

When fully operational, the new computer will centrally process payrolls, appropriation accounting, attendance registers, report cards, and student scheduling on the secondary level for 183 Cleveland schools. In addition, the system will maintain all student and teacher records.

"One of the most important benefits of the system will be its ability to maintain huge masses of information, any part of which can be retrieved instantly," Mr. Briggs said. "This means we have an unprecedented tool for keeping track of students and their progress."

Other proposed application areas include scheduling types of classes and facilities to obtain optimum use of available classroom space. Inventory of all physical equipment in the schools also will be computer controlled.

The Cleveland Board of Education's computer complex will feature two devices:

- IBM 2260 display stations. These desk top units, resembling television consoles with attached typewriter keyboard, depict information retrieved from the computer on a screen. From a terminal located in his office, Supt. Briggs will be able to ask the computer for special information and get a reply channeled directly to his office where answers will be displayed in written form.

- An IBM 2321 data cell storage unit which holds more than 400 million characters of information. Any bit of information can be retrieved in less than a second.

Supt. Briggs also announced that three data processing training centers have been established at Collinwood, John Adams, and West Technical High Schools.

"These facilities are designed to prepare students for technical careers in data processing," he said. "Establishment of the new centers is part of the Board's long-range plan to update the entire vocational program and to gear it to critical job areas."

Navy Computer Systems

Headquarters, Navy Pacific Missile Range
Point Mugu, California 93041

More than 300 of the government's 2,000 [illegible]r digital computers are used by the Navy. Twenty-one of them are used by Point Mugu commands. Five new digital computers are on order here.

The Navy at Point Mugu uses computers across the whole spectrum of their capabilities. These uses include business, technical data processing, and scientific problem solving.

In addition to the 21 major digital computers here, there are a dozen large general purpose analog computers and scores of specialized digital and analog computers in weapons systems and individual aircraft. Analog computers are best known for their ability to solve problems involving motion, such as those encountered in missile and aircraft problems.

The digital computers operated by Point Mugu commands are located here, at San Nicolas Island, at Barking Sands, Hawaii, at Johnston Atoll in the Pacific, and aboard a range ship.

Mugu's latest is a brand new IBM 360 which the Navy Astronautics Group (NAG) uses here to keep tabs on the Navy's navigational satellites. NAG also has an IBM 7094 and an IBM 1410.

The Pacific Missile Range (PMR) test data division has eight computers at Point Mugu—two IBM 7094's, an IBM 1460, an IBM 1401, three UNIVAC USQ-20's, and a UNIVAC 1218. These computers process data from tracking radars, telemetry receivers, and other sources for range users. They also solve scientific and engineering problems.

Another UNIVAC 1218 on San Nicolas Island works in conjunction with tracking radars there.

The Geophysics Division of PMR has a CDC 3100 which it uses for meteorological data processing. The computer reduces upper air data from balloon and rocket-borne sensors and provides launcher settings and ballistic impact prediction for ARCAS meteorological rockets.

The CDC 3100 is tied in to a Navy network of weather computers through the navy's Numerical Weather Facility in Monterey, Calif.

Management and business computers applications are handled by PMR's NCR 315. Payroll, inventory control, security listings, and maintenance control are some of the uses of the NCR 315.

Three Bendix G15's at the Naval Missile Center are available for engineers and scientists working on Navy weapons systems there.

Aboard the PMR range ship USNS Wheeling an RCA 4102 processes data from electronic instrumentation equipment used in support of missile operations far out at sea.

A UNIVAC USQ-20 at Barking Sands, Hawaii, and two at Johnston Atoll in the Pacific handle data reduction for outlying missile launches and tracking operations.

Five additional computers have been placed on order for PMR. They are two UNIVAC 1218's for the instrumentation site on Makaha Ridge, Hawaii, and San Nicolas Island; and three USQ-20's: two at Barking Sands for use in conjunction with the tactical underwater range there, and one to replace the RCA-4102 aboard the USNS Wheeling.

Future use of computers at Point Mugu is currently being studied by a committee appointed by Rear Admiral R.N. Sharp, the range commander.

Heading the committee is John F. Donlan, deputy plans and resources management officer. He is assisted by experts in all phases of computer operation and application.

"Looking 5 years down the road," Donlan says, "we can envision one integrated computer system for the entire base. This is the obvious direction in which computer technology is leading us."

A typical system of the future might contain the main components in one building. Peripheral consoles in areas such as geophysics, comptroller, and range operations could feed in information or query the main system for needed data. The system would speak one computer language.

A recent list of computer language codes contains 114 "dialects" which various makes of computers "speak." A quick look reveals such languages as FORTRAN II, COBOL, ALTRAN, JOVIAL, TRANSUSE, and SLEUTH—which it may take to decode the rest of them.

"Modern developments in electronics and in computer systems are bringing the single integrated computer system closer every day," Donlan noted.

For the Navy, which was first with radar, first to experiment with nuclear energy, and first to launch multiple satellites on a single booster, the modern computer is a natural ally in the continuing assault on the technology of the future.

IBM 360/67

State University of New York at Buffalo
Buffalo, New York 14214

Students and professors will have "desk-side" access to a powerful, $3 million time-sharing computer when the State University of New York (SUNY) at Buffalo installs an IBM System/360 Model 67 near the projected $130 million Amherst campus in the summer of 1967.

With this most modern facility, they will be able to work out problems step by step, miles away from the Amherst center.

Here is how a university researcher, whether student or teacher, might use the time-sharing system:

Faced with a problem that might take him hours or even days to solve with a slide rule or a desk calculator, he decides instead to use the computer. To do so, all he has to do is go to his office, or a room in his residence hall, where a remote terminal, which is connected to the computer itself, is located.

There he types instructions that are relayed directly to the computer, which might be several miles away. Almost immediately, the computer sends back a "reply."

If the reply is sufficient, the researcher has his answer, and that's all there is to it. If not, the computer and the researcher can carry on a "conversation" in computer language via the typewriter terminal until the necessary information is in the researcher's hands. Often the computer can even tell him when he makes a mistake.

Plans are underway which would even make the powerful computer resources available to State University of New York colleges and other schools throughout Western New York by means of a wider network of remote terminals.

Eventually 200 or more locations may be linked to be computer. To each user, however, it will appear that the computer is instantly available and working for him alone. This will be true whether the system is used for classroom assignments or advanced research projects.

"It is difficult to over-emphasize the advantages that the Model 67 will offer to students and faculty here," said Dr. Anthony Ralston, Director of the Computing Center. "We've been looking forward to time-sharing capability for some time now, and there will be a dramatic difference over our present computing setup when we start installing the terminals."

Dr. Ralston noted that the time-sharing nature of the new system refers to its ability not only to handle a variety of problems from remote terminals, but also to process many jobs at the same time. This is accomplished through special programs which enable the computer to switch from job to job at top speed.

The IBM System/360 Model 67 is specifically designed for advanced time-sharing applications involving remote terminals. SUNY at Buffalo initially will install 50 terminals. Later on, smaller computers, such as the IBM 1130 and 1800, will also be used to prepare computations and transmit them to the central processor.

"Because the current Computing Center space is not adequate for the Model 67, we expect to install the new system in space near the new Amherst campus in the summer of 1967," said Dr. Ralston. "From there it will be linked through ordinary telephone lines with terminals on the Main Street campus and wherever else they are needed."

"The Model 67 will give us roughly six to eight times more computing power than we now have."

"We are investigating the possibility of developing techniques in computer-assisted instruction. With the greatly expanded enrollment we anticipate in 5 years, this should be a real aid to teachers."

The University will install a System/360 Model 40 next fall. Several terminals will also be installed to provide training and experience before the Model 67 arrives.

IBM 360/67 for Purdue

Purdue University
Lafayette, Indiana 47907

Purdue University is in the process of solving a major problem confronting many large firms and institutions: How can you economically provide a great number of persons with quick access to a large scale computer system?

The answer, as Purdue officials see it, lies in the full utilization of a revolutionary computer concept called "time sharing." This is an operation in which a single computer system allocates "slices of time," measured in millionths of a second, on a rotating basis to many users.

These users, working at remotely located terminals, simultaneously may work many kinds of problems requiring many different

computer functions. The speed of the machine's operation is so fast that individual users don't realize that many other persons may be on the computer at the same time—each feels as though he has the full power of a large scale system at his disposal.

L.J. Freehafer, Purdue vice president and treasurer, said the university has placed an order with International Business Machines Corporation for its new time sharing computer, System/360 Model 67. Also ordered were a number of IBM 2260 television-like communications terminals for location at strategic places throughout the campus; an IBM 2250 graphic display, which permits display of information in the form of sketches, drawings, diagrams, and graphs, and several IBM 1978 read-print stations.

"Purdue is one of the few major universities in the world offering degrees through the doctorate level in computer sciences," Freehafer said. "This new system, which incorporates the most advanced concepts in computer technology, will enable Purdue to maintain its pre-eminence in the field."

Impressive statistics point up Purdue's requirements for increased computing power:

- More than 100 different classes in all nine major areas of specialization have assignments that require computer processing. This means that in any given semester at least 5,000 students will need time on a machine.

- Approximately half of Purdue's five-campus total of 27,793 students take computer courses before graduation. It is estimated that by 1970, about 4,000 students will be taking computer courses every semester.

- At any given time there are about 600 students and 500 faculty members doing research who need the computer for problem processing.

- More than 100 students currently are working toward graduate degrees in computer sciences. The growth of this field is illustrated by the fact that the graduate program began only 4 years ago with five students.

Freehafer said the computer system will be installed in the university's new 13-story Mathematical Sciences Building, now under construction.

First units of the System/360 will be installed when the new building is completed in the fall of 1967. Additional equipment will be added later to create a "dual system"—in effect, two computers which may operate together or independently.

Professor Felix Haas, dean of the Purdue School of Science, said the Model 67 will be the key element in the school's rapidly growing Computer Sciences Center. "Order of this new data processing system," he commented, "reaffirms Purdue's commitment to make available enough computing power to meet the demands of a growing number of students and faculty."

The current IBM 7094/1401 computer system is scheduled for operation 24 hours every day, often processing up to 1,400 problems in that time span, Dean Haas said. "When the Model 67 is put into operation, we will have the power to speed problem turnaround on current applications and still have considerable allowance for expansion."

Professor Samuel D. Conte, director of Purdue's Computer Sciences Center and head of its Computer Sciences Department, said this burgeoning use of central data processing facilities has created two major problems.

First, there is a small but fixed amount of time required to begin computation of any problem. For small problems, this "overhead" may exceed the time for the solution of the problem itself. This restriction becomes serious when hundreds or even thousands of jobs must be processed each day.

Secondly, the diverse range, as well as the large number of users, places demands on a system which cannot be met by computers at a single geographic location. On the other hand, proliferation of smaller machines throughout the campus would be expensive and would spread resources too thinly.

"The time sharing concept, using terminals placed at strategic locations in all schools, is suited to solving both of these problems," Conte said. "The geographical problem, with all its implications, becomes nonexistent because users at terminals can operate just as though they were at the control console of the computer. The vast number of programs required for a central operation of this magnitude all can be maintained in the Model 67's almost unlimited direct access disk files."

Locations for the first 30 visual display terminals have not yet been fixed, according to Conte. "Each school will analyze its computer

requirements to determine if its needs can be met most economically by using the remote system or by the normal batch processing system now in use. When these studies are complete, the first terminals will be assigned."

He pointed out, however, that the Model 67 can handle up to 200 terminals and that additional units will be added to the system as required.

Both Haas and Conte emphasized that Purdue's use of the time sharing system is not limited to the Lafayette campus. The university has four regional campuses—in Fort Wayne, Hammond, Michigan City, and Indianapolis. "Each has its own computer and we definitely are looking into the advantages of linking the regional systems to the central computer in Lafayette," Haas said.

In addition, according to Conte, several smaller colleges in Indiana and surrounding states have expressed interest in tying in to the time sharing operation.

"The flexibility of System/360—its ability to add capacity and power as requirements grow—will enable Purdue to meet all of its computer needs in the foreseeable future," Conte said. "We are determined that Purdue gets the most out of its computing dollar and that, at the same time, it continues to be a leader in the field."

Triangle Universities Computation Center

Research Triangle, North Carolina

The establishment in North Carolina's Research Triangle of one of the world's largest university computer centers and grants of $1.5 million from the National Science Foundation were announced in February by representatives of the three Research Triangle Universities.

The unique venture in computer sciences is expected to provide statewide computer services for Tar Heel colleges and universities in the near future.

Initially, it will provide top-quality computer instruction and research service for 28,000 students and several thousand administrative, faculty and staff personnel at North Carolina State University at Raleigh, the University of North Carolina at Chapel Hill and Duke University at Durham.

Grants of $500,000 were made to each of the three campuses for the computer center. The total of $1.5 million will help defray costs of the recently formed Triangle Universities Computation Center (TUCC).

TUCC is a non-profit corporation set up by the three universities to upgrade computer instruction and services. Dr. James K. Ferrell, a professor of chemical engineering at N.C. State, is serving as first president of TUCC. He noted that the NSF grant, along with earlier support from the N.C. Board of Science and Technology, will enable the Center to get into operation with temporary equipment within the next few weeks and to become fully equipped by August.

This will be two years ahead of the opening anticipated by the N.C. Board of High Education when it recommended formation of the center in 1964.

The joint university ownership arrangement is among the first of its kind, Ferrell said, and may very well set a precedent for future educational computer services.

It is unique in that none of the cooperating universities will need to go to the Research Triangle to use the center. Smaller on-campus computers will be hooked directly to the center by telephone wires.

Computer problems of professors, officials, and students will be initiated on campus and fed directly into the wire. An answer to the problem will be returned in 2 or 4 minutes.

"It's exactly like having a very large computer on each campus, except that it costs less," said Dr. R.B. Des Jardins, chairman of the UNC Computer Users Committee.

Officials emphasized that in the near future computer services would be available to colleges across the state through teletype hookups.

The giant new computer to be used in the center will be capable of reacting to an incoming message in a few millionths of a second. With this speed, transmissions from a large number of campuses can be made simultaneously.

The key equipment at TUCC will be an IBM System/360, Model 75 Computer. This is the largest and fastest computer presently manufactured by IBM and is about 10 times faster than the speediest computers now in use on North Carolina campuses. It will offer a comparable increase in memory size. It will be able to add a column of one million ten-digit numbers in less than a second.

Located on each of the Triangle campuses will be an IBM System/360, Model 30 unit for high speed transmission between the campuses and the center.

Each campus also will have a variety of medium and low-speed terminal devices connected to the center to make computer facilities more readily available to faculty and students.

One of the big advantages of the new system is that all computer projects will be in the same language, so that one school will be able to use another's program, if they are working in the same field.

But the switchover to this new computer will present some difficulties. Each university now has a different computer and thus many different problems. UNC, for instance, has a computer that doesn't even talk the same language as the new one. A vast programming conversion is now under way.

Policies for the center will be set by a TUCC Board of Directors composed of three representatives from each of the three campuses. Chairman of the board is Dr. T.M. Callie of Duke University.

Other members are G.C. Henricksen and Dr. Earle C. Fowler of Duke; Dr. E.D. Palmatier, Erwin M. Danziger and Dr. F.P. Brooks of the University of North Carolina at Chapel Hill; and Dr. Paul E. Lewis, John D. Wright and Dr. D.D. Mason of North Carolina State University at Raleigh.

A staff of 22 persons will operate the Computer Center which will be located in the new headquarters of the N.C. Board of Science and Technology at the Research Triangle Park. The facility is known as the N.C. Science and Technology Research Center.

The Board of Science and Technology provided funds to construct a new wing to the building to provide housing for the Computer Center. The computer complex itself will occupy about 3,100 square feet of floor space.

Among the chief advantages of the new computer there will be its easy accessibility to students and faculty. It will be used extensively in educational programs especially in engineering and the sciences.

Dr. P.A. Lachenbruch of the Department of Biostatistics at UNC said that his department will benefit greatly from the new computer.

"The main advantage for us," he said, "is the flexibility to input and output devices on the new machine. There will be much easier ways to manipulate it, and this ease will make consulting much easier for us. We do a great deal of consulting, and we will be able to do much more now." "We also will be able to take other bio-medical programs and apply them to our own programs here, which was very difficult before," he said.

Dr. Alden Lind, professor in political science at UNC, works with the computer, too. "This 360/75 will provide us with a language most political science people speak," he said.

Dr. F.P. Brooks, Jr., chairman of the Department of Information Science at UNC, noted that at UNC there will be a screen, like a TV screen, hooked up to the computer. The user can draw a "picture" program on the screen to tell the computer what to do, and the computer can draw back its answer.

Dr. Gallie, chairman of the TUCC board and associate professor of mathematics at Duke, said that Duke would use the computer extensively for research in high-energy physics and in medicine. He said the computer would both speed up research and provide greater accuracy in research complications. "By joining together in this venture, the three Research Triangle Universities will have a computer capability comparable to the finest in the country," he said.

Nationwide Departmental Computing System

U.S. Department of the Interior
Washington, D.C.

The Department of the Interior, in May, announced the selection of a large-scale general purpose computer system to be installed in the U.S. Geological Survey. The system will firmly link field locations throughout the country to a central installation in Washington, D.C.

As a result of competitive proposals, International Business Machines Corporation was chosen to provide computers for the system. The central computing complex will provide a wide spectrum of computational services to the Department of the Interior in the Washington area, as well as serving the total administrative, scientific, and data processing needs of the Geological Survey.

"Hundreds of our scientists and engineers working on such projects as creating geologic and topographic maps of the moon; analyzing underground nuclear tests or the earth's quake-producing fault structures; and studying mineral and water resources, will have a uniquely powerful tool at their fingertips in the new computer network," said Director W.T. Pecora of the Geological Survey.

"For example," Pecora said, "the vast accumulation of information required to deal with water scarcity and with pollution in the Nation's watersheds can be stored in the memory of the system. These essential data will be almost instantly accessible to local, state, and federal authorities seeking to manage water resources."

An IBM System/360 Model 65 will be located at the Department of the Interior in Washington, D.C., as the hub of the system that managers, scientists, and engineers across the Nation will use.

IBM System/360 Model 20 computers will serve as terminals at field offices in Denver, Colo., Flagstaff, Ariz., Rolla, Mo., and Menlo Park, Calif., and will be connected to the Washington complex by telecommunication circuits. Other locations are expected to be connected to the system following establishment of the network.

Scientists and engineers of the Water Resources, Geologic, and Topographic Divisions of the Geological Survey will be able to use the speed and power of the central computers when they enter problems into the system through a computer at one of the four field offices. Within minutes, printed results will be returned to the original sender by telecommunications.

First equipment deliveries have been scheduled for the fourth quarter of 1966 with the final system to be completed early in 1967.

UNIVAC 1108 Computer

University of Utah
Salt Lake City, Utah 84112

The purchase of a $2-million dollar Univac 1108 computer has been approved by the University of Utah Board of Regents. President James C. Fletcher said the high speed computer will be paid for over a 5-year period by income from Federal research grants and the Sperry-Utah Company, Division of Sperry-Rand Corporation.

"We will have one of the most powerful computer facilities in the world," said Dr. Louis A. Schmittroth, director of the University's Computer Center. The new computer will be purchased from the Univac Division of the Sperry-Rand Corporation and installed in October 1967. It will replace all current computer equipment and will increase the center's capacity at least ten fold.

"The Univac 1108 will open opportunities for better man-machine communications," Dr. Schmittroth said. It features input-output terminals which can be installed anywhere on or off campus. One of them will be established at Sperry-Utah plant, a prime contractor of the Army's Sergeant Missile system. Up to 50 projects can be run through the Univac 1108 simultaneously from the terminal points. The 1108 can accommodate up to 200 separate terminals.

Professor David C. Evans, director of the University's Computer Science Program, said

the new machine would also be of great academic value. "It will become a major instruction and research tool in the newly organized computer science program and will support major research in computer graphics and man-computer systems," he said. Professor Evans explained that at least 2,000 students currently find some need for the services of the Computer Center. "The new equipment will make the experience more efficient and meaningful for these students," he said.

Dr. Schmittroth said access to such a powerful computer "will be a real drawing card for the University's Research Park." For example, he said the Univac 1108 will allow the Fluidonics Division of the Imperial-Eastman Corporation–first occupants of Utah's Research Park–to design new fluidic devices by computer simulation. A Fluidonic official explained that the new computer will provide solutions to the fluid flow equations used in Fluidics at six times the speed of the present computer equipment.

An added advantage of the new facility will be the advanced methods in which the computer will be used to store users programs and process their data.

Computers and Centers, Overseas

Worldwide Reservations Network

Air France
Paris, France

In May, Air France announced the signing of a purchase contract with the Univac Division, Sperry Rand Corporation, for a new electronic reservations system, which will assure increased speed and expansion of service to clients throughout the world. The French airline is the first European airline to make such a purchase.

The new system will handle a passenger's reservations and other pertinent travel arrangements in a fraction of a second at any time of day or night. Messages will be transmitted with equal speed to any part of the world concerning space availability on a desired flight, and immediate alternates on any route segment combination itinerary routings.

In addition to instantaneous passenger service concerning space availability and reservations, the system will register full name, telephone contact, stopovers, and if desired, car or hotel reservations, special in-flight diet menu, ground excursions, connecting flights on other airlines, and many other travel details. It will also be possible to question the memory bank and receive immediate reply on fares, timetables, vaccinations, and public health and immigration formalities for various nationals visiting a certain country or series of destinations.

The new Univac equipment, scheduled for early 1968 service in the French airline's reservations system, is designed for year by year expansion through 1977, to meet traffic growth and augmented service needs. Initially, the central unit will be linked with 561 reservation agent units and 92 teleprinters located in Paris and 19 other reservations centers in five countries. By 1977, the electronic system will join 1,105 reservations agent units.

Early in 1968, Paris will be linked with 19 cities, namely, Ajaccio, Bastia, Bordeaux, Lyon, Marseilles, Nice, Strasbourg, and Toulouse, as well as Berlin, Dusseldorf, Frankfurt, Hamburg, and Munich. Also London, Manchester, Milan, Rome, Geneva, and Zurich. In rapid succession, principal cities served by Air France in the United States, Canada, and Mexico will be linked to the airline's new electronic reservations system. Subsequently, all major cities on the French airline's worldwide network will be joined to the new reservations system.

A GIANT ELECTRONIC SERVICE SYSTEM

The agent units, assuring quick service to the public, were designed by Raytheon Company, and will be manufactured in France under license by Marcel Dassault Electronic Company. These digital information display systems units are made up of a keyboard to send questions to the electronic memory bank, and a television type screen on which instantaneous replies are displayed in twelve 42-character lines.

The reservations agent units in various countries will be linked with the central memory bank in Paris by telecommunication equipment manufactured by the Thomson Houston Company, and will make use of circuits rented exclusively by Air France. Loop circuits will link all cities in the same geographical region, thus avoiding the consequences of cutout at any particular city.

The new reservations memory bank, composed of two giant capacity Sperry Rand Univac 1108 Multi-Processor electronic calculators, will be installed at Air France's Electronic Center located on Boulevard Blanqui in Paris. Each calculator is made up of two memory banks, each in turn capable of registering 65,000 six-character words, and will be linked with 10 auxiliary memory drums with a 327-million character capacity by 1977.

This giant capacity will permit reply in an hour's time, for example, to a total of 100,000 questions made up of 20,000,000 characters. Thus, agent units throughout the world will be able to question the central unit simultaneously and receive immediate reply for exceptionally quick and efficient client service.

Air France's new electronic reservations system will be, at once, an instrument of increased client service, and augmented corporate productivity and efficiency. The giant electronic service system will also permit handling of cargo reservations, freight inventory, flight plans, crew and aircraft rotation, supply inventory control, statistical studies, and many other information needs of the world's largest airline and its clients in 118 cities in 61 countries.

Hybrid Computing System

Cambridge University
Cambridge, England

Cambridge University has ordered from Elliott-Automation a £180,000 'hybrid' (part digital, part analogue) computing system for fundamental research into the problems of applying automation to the control of industrial processes. Success in this field could lead to large increases in productivity in many industries and the Science Research Council has recently awarded a grant of £273,000 to support the work in the Engineering Department at Cambridge.

The installation will be the largest in Britain to incorporate both a complete digital computer and a complete analogue computer linked together to form a single computing system. It is to be delivered by the end of the year.

The principal aim of the team, working under Professor J.F. Coales, Professor of Control Engineering at Cambridge, is to find generally applicable methods for the design of control systems for complex industrial plants. This necessitates first of all the construction of accurate mathematical models of industrial processes and from these the compilation of efficient control strategies for the various types of plants. The existence of such data will simplify enormously the task of applying automation to many industrial processes, leading to gains in productivity which will enhance the competitive position of many British goods in export markets.

EXPERIENCE

An important by-product of the project will be the accumulation of a wealth of first-hand experience of the design and use of powerful hybrid computer systems of this type.

The digital part of the system will be an NCR Elliott 4130 computer, with 16,000 words of 2-microsecond memory, and the analogue part will be two 231R Mk. V computers, manufactured by Electronic Associates Ltd. These machines will be linked together by special interface equipment. Elliott's are responsible for the design and engineering of the complete system and for supplying the special computer programes (software) which will be required.

In general terms, the analogue computer will be used to simulate the functioning of industrial plants and the digital computer to control and optimise the overall plant performance. It is necessary to use a hybrid system for this research because an analogue computer can reach an approximate solution to the simultaneous differential equations, which represent the processes in mathematical terms, very much more quickly than can be achieved by digital methods.

A digital computer must be used to turn these approximate solutions into precise mathematical terms, but its principal role in the system is to measure and optimise the performance data, represented by the solutions to the equations, and to reset the process parameters before initiating a new cycle of operations. The digital computer then goes on to compare the results achieved with actual plant performance data. At a later stage, when the automation study has got properly under way, the NCR Elliott 4130 may be used for multi-program working on other computing problems within the Engineering Department.

Programs will be written in ALGOL and FORTRAN, which are both compatible with the real-time operation of the system. An interesting software development will be the writing of hybrid programs, using FORTRAN with sections of machine code or symbolic language embodied in it.

NCR Elliott 4100

Elliott-Automation Computers Ltd.
Borehamwood, Herts, England

The first production models of the NCR Elliott 4100, Britain's most advanced low cost, multi-purpose computer, have been delivered to the Aircraft Research Association and British Telecommunications Research Limited. Shortly before delivery it was announced that the operational speeds exceeded the specification by 25 percent. The specification has been increased accordingly, offering an even better cost-performance ratio at an unchanged price. The first installation was delivered to the Aircraft Research Association's Bedford Laboratories where it will be used for research into high speed flight at up to six times the speed of sound. These conditions are simulated in high speed wind tunnels and the Association's existing Mach 1 and Mach 4 tunnels are being augmented by a Mach 6 tunnel which is nearing completion.

GRAPHICAL DISPLAYS

The extremely high velocities in the two smaller tunnels are obtained by compressing air into steel containers and releasing it into the wind tunnel under controlled conditions. The tests last for only a few seconds, during which the aerodynamic properties of experimental shapes are measured and recorded under varying conditions and airspeeds. Tests are often continued over several days during which a mass of complex data is recorded. This is subjected to detailed analysis and examination before the final results are obtained.

This work will now be largely taken over by the computer, which will include a 4120 central processor, 6-microsecond store, paper tape station, control typewriter, two data disc handlers, and a digital plotter. The system will provide the results in a fraction of the time formerly taken, and in addition to presenting the information in the form of statistical tables it will also provide graphical displays on the digital plotter.

The installation will also be used on a wide range of theoretical and practical work carried out at the laboratories, including the design of experimental models for use in the wind tunnels.

EXCHANGE SIMULATION

The system delivered to British Telecommunications Research Ltd., a member of the £180m. Plessey Group, will be used to assist with advanced research in the telecommunications field at the Company's Taplow Court Laboratories.

A choice of core store memory units, operating at speeds of 2 or 6 microseconds, is available for use with both the 4120 and the 4130 central processors, enabling the system to be expanded or speeded up as the volume of work increases. The 2-microsecond memory can be attached to the 4130 processor in modules of 16,384 or 65,536 words. The normal maximum of 262,144 words of immediate access core storage will be extended to over half a million words for a number of special applications.

A 4100 data processing system for a typical scientific or research application, consisting of the 4130 central processor with an autonomous transfer unit for multi-programming purposes, paper tape input and output channels, line printer, and two random access stores would cost approximately £90,000.

A 4100 system for a typical business application, consisting of the 4130 central processor, with multi-programming facilities, 32,000 words of 2-microsecond store, six 33-kc magnetic tape files with simultaneous read-write facilities, paper tape input and output channels, and a 1,000-line-per-minute printer would be approximately £135,000.

The BTR installation consists of a 4120 central processor, two 6-microsecond stores, each of 8,192 words, paper tape station, and control typewriter. The system will be applied to a wide range of scientific work connected with systems design and evaluation. Engineers will be able to write and run their own programs on the computer; programming courses have already been held at Taplow Court for this purpose.

In addition to its normal data processing role, the 4100 will play an important part in

BTR's work on crossbar and electronic telephone switching systems. By simulating the operation of complex telephone networks, the computer will yield important statistical information including the anticipated call failure rate for given exchange configurations and traffic patterns. By this method, an optimum balance between cost and performance can be determined while exchanges are still at the design stage.

The NCR Elliott 4100 is an entirely British system, designed as well as manufactured by Elliott-Automation. Marketed jointly with NCR, it has been ordered for business, government, scientific, and research applications. Production is centred on the Company's Borehamwood and Cowdenbeath factories, and provision is being made to expand production still further to cater for an expected increase in demand.

CHOICE OF PROCESSORS

Recently, a powerful new central processor and a high-speed memory capable of storing more than a quarter of a million words were added to the 4100 range, which was introduced earlier this year.

The new central processor, the 4130, is fully compatible with the smaller 4120 unit, but is faster and more flexible, offering multiprogramming facilities and incorporating many built-in features such as high-speed floating point arithmetic. Multi-access working with the 4130 processor will enable many different people to use the machine at the same time.

IMPROVED PERFORMANCE TIMES FOR 4100 SYSTEM

Operational speeds achieved with the 4120 central processor of the NCR-Elliott 4100 data processing system exceed the original specification by over 25 percent. The specification has been increased accordingly, offering an even better cost-performing ratio.

This increase in operational speeds applies to systems with both 2- and 6-microsecond stores. Typical improvements in floating point and fixed point arithmetic times are shown in the following table:

Operations	Fixed Point Times in Microseconds				Floating Point Times in Microseconds			
	6 μs Store		2 μs Store		6 μs Store		2 μs Store	
	Old	New	Old	New	Old	New	Old	New
Logic step	1.5	1.1	1.5	1.1	1.5	1.1	1.5	1.1
Addition	12.0	12.0	6.0	4.5	362	347	212	162
Multiplication	87.0	67.0	81.0	59.5	735	661	525	382
Division	88.5	68.1	82.5	60.6	709	634	500	369

SDS Computer Manufacturing and Marketing

G.E.C. Computers and Automation Ltd.
Wembley, Middlesex, England

G.E.C. Computers and Automation Limited will manufacture and market in the United Kingdom the new "Sigma 7" computer announced by Scientific Data Systems, Santa Monica, California.

This is a third generation computer which makes extensive use of monolithic integrated circuits, is designed to provide a total capability for real-time computing in scientific and business data processing, and operates in the time-sharing, multiprocessing, and multi-programming modes.

The result of an intensive 2-year development programme, this represents the first range of computers based on entirely new design techniques to be introduced since the IBM 360 announcement.

British manufacture of the computer will be carried out in Coventry. G.E.C. Computers and Automation will offer the machine as an extension to its existing Series 90 range of computers, at a price around £200,000 depending upon the configuration of individual systems. Machines from the United Kingdom production programme will be delivered in 1967.

An exceptional feature of the computer is its time-sharing capability. It is the first medium-priced, real-time machine to be developed for this application. For example, the computer can service more than 200 remote users simultaneously, each virtually having exclusive use of the machine, while at the same time it can be batch-processing management and control programs. Despite the complexity of time-sharing operation, the computer's unique hardware and software design enables it to detect and respond to a high-speed real-time situation in a few microseconds, without losing control over the other problems already being processed.

This degree of power is achieved by embodying in the computer all the industry's latest advances. Many of its features are exclusive to the new computer or otherwise available only in machines costing some £1,000,000 or more.

An example of this is a feature known as mapping. This provides for the efficient management of the computer's storage capacity, an essential aspect of time-sharing operation. Using mapping, each user's program is routed into the available sections of the computer store, which may be widely scattered. Addressing is automatically adjusted so that the program appears to the user as though it occupies a single continuous block in the store.

This feature also enables the same program to flow into and out of different fragments of the total store during each period that it occupies the machine.

Because of its unique logical organisation, this is the only computer in the industry which can completely change its environment from one program to another in 6 microseconds. This feature provides the capability for processing such critical real-time applications as aerospace and industrial control, nuclear experimentation, communications switching and control, and at the same time provides for general purpose computing in multi-usage environments.

COMPUTER DATA SHEET

Store Capacity	524,288 bytes (4,096 to 131,072 words) expandable by increments of 4,096, 8,192, 12,288, or 16,384 words.
Store Cycle Time	1.2 microseconds; 700 nanoseconds[1]
Word Size	32 bits (four 8-bit bytes) plus parity[2]
Maximum Memory Module Speed	26 million bits per second

[1] Effective Cycle time when overlapping occurs.
[2] IBM 360 format includes 64-bit floating point, decimal arithmetic and byte string manipulation.

COMPUTER DATA SHEET (Continued)

Registers	16—expandable in blocks of 16 to a total of 512
Major Instructions	110
Instruction Execution Speeds[3] (Microseconds)	Load word 2.0 Multiply 4.9 Add 2.0 Divide 12.5
Maximum Number of External Priority Interrupts	224
Special Features	Overlapping, Interleaving, Mapping, Multiple Register Blocks, Memory Protect, Real Time Clocks, Input-output Processors, Asynchronous Operation, and Monolithic Integrated Circuits
Maximum Number of Input/Output Devices	256
Maximum Input/Output	160 million bits per second
Programming Systems	FORTRAN IV, PL/1, Assembler, Meta-Assembler, Control Monitor, Batch Monitor, Universal Monitor, Library.
Peripheral Equipment	Keyboard printer, paper tape reader and punch, card readers and punches, rapid access disc, 7 and 9 channel magnetic tape systems, 600, and 1,000 line per minute printers, visual display units and communications interface equipment.
Cost of Typical Configuration	£200,000

[3]Speeds include indexing, mapping, and memory overlap.

G.E.C. Computers and Automation Limited is a wholly owned subsidiary of the G.E.C. Its activities include the computer and digital computer control activities previously handled by International Systems Control Limited, and related activities in the field of high speed data transmission and telemetry previously handled by the Industrial Division of G.E.C. (Electronics) Ltd., Wembley.

The Science Research Council I.C.T. Atlas Computer Laboratory

International Computers and Tabulators Limited
London SW 15, England

The Science Research Council's Atlas Computer Laboratory at Chilton in Berkshire has recently taken over the I.C.T. Atlas 1 computer after which the laboratory was named. Final acceptance was in the spring of 1966, by which time the machine was scheduled to maximum capacity—24 hours a day, 7 days a week. The installation, which cost £2.8M, had been operating on a two-shift basis since early May and is now in regular use, three-shifts a day.

The Laboratory, based on this one large computer, is one of the most powerful computing centres in Europe. It provides a service to the following groups of users, in addition to its own mathematicians:

Research workers in British Universities, in any field:
thus it is used in biology, sociology, and literature as well as in the physical and mathematical sciences;

The Science Research Council's own laboratories, including the Rutherford Laboratory (for nuclear physics) and the Space Research project;

The Atomic Energy Research Establishment at Harwell,

Several Government research establishments, including the Meteorological Office, the Road Research Laboratory, and the Medical Research Council.

The power of the Atlas computer derives from the fact that not only is its speed of operation high, but it can handle a number of separate and and unrelated programs simultaneously. A supervisory program within Atlas organizes the work so that the maximum use is made of the data processing facilities of the computer in accordance with the priorities given to the various jobs.

Such is the capacity for work of Atlas that a continuous flow of jobs has to be provided and an unusual operational system has been devised to expedite the input and output of programs, together with their related data. Input data and programs read from punched cards or perforated paper tape are transcribed on to magnetic tape where the jobs are held in a queue on an input tape. From here the jobs are fed into the computer which, as already stated, is capable of performing several programs concurrently. Results are first recorded on magnetic tape–the output tape–and then transcribed from magnetic tape into print, or punched in cards or paper tape as required. Transcription of the input data and the results is performed concurrently with other work the computer is performing.

SCIENCE RESEARCH COUNCIL
ATLAS INSTALLATION

The Atlas 1 installation comprises:

a central processor and a core store of 49,152 words capacity (48-bit word)
a fixed core store of 8,192 words capacity
a subsidiary store of 1,024 words capacity
four magnetic-drum stores of 24,576 words capacity each
18 magnetic-tape units
two 600-cards-a-minute readers
one 100-cards-a-minute punch
two 1000-lines-a-minute printers
a master console with typewriter and paper tape punch operating at 110 characters a second
a subsidiary console with typewriter and paper tape punch operating at 110 characters a second

The main store is divided into cores and drums, but the programmer can treat it as one integral store of nearly 150,000 words capacity; a built-in program organises any necessary data transfers. There is also a 'fixed store' of 8,192 words made of ferrite and copper slugs set in a wire mesh. This store has an access time of about 0.03 microseconds and holds all the basic programs, such as those for reading and punching cards or paper tape, and computing simple functions.

Basser Computing Department

University of Sydney
Sydney, Australia

The Basser Computing Department currently operates an English Electric KDF 9 (installed early in 1964) and an older machine, a SILLIAC (copy of the original University of Illinois machine), which was put into service in mid 1956.

It is anticipated that before the end of 1966 the Department will have a 7040/1401 and a 1700.

A summary of existing and planned equipment is given in the following table:

Processor	Manufacturer	Word of character length (bits)	No. of words (of characters) in high speed store	Peripherals	Date of delivery to Dept.	Remarks
SILLIAC	Basser	40	1,024	4 m.t. units 1 p.p.t. reader 1 p.p.t. punch	July 1956	Connection to KDF 9 now complete
KDF 9	E.E.L.M.	48	16,384	4 m.t. units 2 p.p.t. readers 1 p.p.t. punch 1 l. printer 1 cd. input 1 plotter	April 1964	All peripherals on separate channels
IBM 7040	I.B.M.	36	32,768	4 m.t. units	Nov. 1966	Interconnected to 1401. 2 m.t. units connected to 1401 can be switched (manually) to 7040
IBM 1401	I.B.M.	6	16,384	2 m.t. units 1 p.p.t. reader 1 card reader punch 1 line printer	do.	See above. There is a programmable switch controlled from the 1401 which enables information to be passed to 7040 or 1700
CDC 1700	C.D.C.	16	12,288	Disc file 58.2×10^6 bits 2 teleprinters 1 character display	Nov. 1966	To be interconnected to KDF 9 and (through 1401-controlled switch) to 1401

At the present time, the KDF 9 has been connected to SILLIAC so that the four SILLIAC tapes can be used. It is intended that the CDC 1700 will serve as a message-gathering unit for remote console service, to be run jointly with the other equipment. A switch operated by program from the 1401 will enable information to pass, according to its position, either between 1401 and the 1700 or between the 1401 and the 7040.

Miscellaneous

ADP Management

Bureau of the Budget
Washington, D.C. 20503

The Director of the Bureau of Budget has announced establishment of a separate branch within the Bureau's Office of Management and Organization to assist him in carrying out his responsibilities for management of automatic data processing within the executive branch of the Government. He has appointed Joseph F. Cunningham, formerly Associate Director of Data Automation for the Department of the Air Force, to head the new branch.

The new ADP Management Branch was established to carry out the responsibilities specifically placed on the Bureau by P.L. 89-306 and by the President's approval of the recommendations in the 1965 "Report to the President on the Management of Automatic Data Processing in the Federal Government." The establishment of this new branch is part of the increased Government-wide attention being given to ADP management by the Bureau of the Budget, the General Services Administration, and the National Bureau of Standards.

Under its basic responsibilities for management improvement, the Bureau of the Budget provides policy direction and guidance to all agencies of the executive branch with respect to the management of automatic data processing. Under P.L. 89-306, policy and fiscal control for the Government-wide ADP responsibilities assigned to the General Services Administration and the Department of Commerce by the Act will also be provided.

In addition, the Bureau of the Budget will strengthen its resources to:

- Evaluate the effectiveness of ADP management practices of individual agencies as well as the executive branch as a whole.

- Provide a basic Government-wide information system to assist officials in properly managing ADP equipment and related resources.

- Sponsor a program for the standardization of data elements and codes that are in common use among Federal agencies.

- Promote the use of advanced techniques in the design of data processing systems, including the integration of systems on an intra-agency and interagency basis.

Mr. Cunningham, who heads the new branch, has been with the Air Force in the management information field for 25 years, including service as an officer in the Office of Statistical Control during World War II. He has been associated with the Air Force's ADP program since early in the fifties. He was a member of the project staff which prepared the report to the President on "The Management of Automatic Data Processing in the Federal Government," and has been chairman of the Interagency Committee on ADP. He is a member of the American Management Association, Association for Computing Machinery, and has served as Vice Chairman and Chairman of the Conference on Data Systems Languages (CODASYL). He is an adjunct professor in the School of Government and Public Administration of the American University.

Computer Aided Instruction

University of California
Santa Barbara, California

Selected classrooms at the University of California at Santa Barbara were equipped in September with computer display consoles to help students and teachers solve a variety of problems in mathematics, engineering, and the sciences.

Chancellor Vernon I. Cheadle today announced that during the summer the university installed an IBM computer, a System/360 Model 50, to implement an advanced research and instructional system. Plans call for equipping classrooms in five departments with display consoles for experimental use in a variety of courses including calculus, electrical engineering, sociology, and psychology.

Frederick T. Wall, Vice-Chancellor for Research, said the System/360 incorporates the latest computer technology and will be the first large-scale system on the UCSB campus. The computer will be available for classroom work during the fall quarter.

Using a technique called on-line computation–developed by Dr. Glen J. Culler, Director of the UCSB Computer Center, and Dr. Burton D. Fried, Professor of Physics at UCLA–a time-sharing system eventually will link various other universities throughout the country to the computer via a network of telephone lines.

The display consoles, called "teleputers," consist of a calculator-like keyboard labeled with mathematical symbols and a screen similar to a television tube. A student or researcher enters his problem into the computer through the keyboard. Each step toward a solution may be displayed on the screen in numerical or graphical form, as desired by the user.

"The capabilities of this system will broaden the boundaries which have traditionally limited the study of mathematics and the sciences," according to Dr. Culler. "For the student, the system will help provide a better grasp of the abstract concepts common to these fields. The student who is able to see successive steps in an experimental solution to his problem gains many insights not available with the traditional theoretical approach.

"For the researcher, the speed and advanced problem-solving capability of the new system will enable him to extend his investigations into areas which have been too complex for solution using ordinary techniques."

Teachers, by means of a master console, will be able to monitor each of the students in a classroom and review their progress. The teacher can also construct examples of problems on his console and display the images on all other stations in the classroom.

Presently, there is also a 16-console classroom on campus linked to a smaller computer. Consoles at UCLA and the Harvard Computation Laboratory, Cambridge, Mass., also are linked to this computer by telephone lines.

Use of the computer for research projects and classroom instruction is supported by the National Science Foundation, the Office of Naval Research and the Advanced Research Projects Agency of the Department of Defense.

The System/360 includes a central processing unit with 262,144 characters of core storage; an additional bulk core storage unit with two million characters; four magnetic disk storage units, each with a 7.25-million-character capacity; a magnetic drum which stores almost four million characters and transfers them to the computer at the rate of 312,000 per second.

Ocean Training Space Surveillance System

Cornell Aeronautical Laboratory, Inc.
Buffalo New York 14221

A radar-plus-computer surveillance system to monitor air, sea, and sub-surface ocean traffic, based on a system design of Cornell Aeronautical Laboratory, is now providing the U.S. Navy with a method of safely conducting complex, large-scale training operations off the Southern California coast.

Known as the Navy's Fleet Air Control and Surveillance facility, centered at the North Island Naval Air Station near Coronado, California, the system provides more efficient use of the controlled area for airborne, surface, and subsurface operations. By computer tracking and projection, the system is designed to warn all craft of impending hazards in time to avoid accident situations.

Increased operations in the large, reserved training areas underlie the need for the surveillance system.

As the first of several contractors involved in the program, CAL was selected by the Navy

in 1962 to design a monitoring and control system tailored to the Navy's shipboard digital computor, the CP-642A, and its associated data processing and display equipment.

Under a $286,000 contract, CAL proved out the feasibility of the Navy's plan and laid out the preliminary design of the system required.

The west coast center began operations late last year and is a prototype for the Navy which plans a number of such installations on both coasts.

Radars at two locations track aircrait in the reserved space, and the information is fed by a microwave relay into the computer, where it is digested and immediately displayed on banks of surveillance consoles.

The computer program was designed and written by Cornell Lab and then checked out on the control system computer to assure that control and surveillance functions were suited to the complex tasks. CAL's control concept also provide for expansion of the system in the event that additional computers, radars and data links are desired.

Remote Computer Demonstration

Cornell University
Ithaca, New York 14850

A group of high school juniors visiting Cornell University in April learned some of the marvels of engineering by playing an ancient Chinese number game with a two-ton opponent 150 miles away.

The game was part of the 26th annual Cornell Day held to let young students learn what college is all about and to see what Cornell has to offer them. About 500 male students from 45 Northeastern cities converged on the Cornell campus to take part in the two-day program. Although other universities have similar programs, Cornell's is believed to be the only one in the country that lasts more than one day.

The game with the General Electric 265 time sharing Computer was arranged by two promotion minded Cornell students, Bradford M. Smith, 23, of Erie, Pa., and William W. Frayer, 21, of Binghamton. The resourceful pair, both electrical engineering students, decided they wanted to arrange something unusual to present to the visitors.

"We could have used lasers and played like James Bond," Frayer said, "but we finally decided on a computer because the visitors could participate."

While Frayer was getting permission from General Electric to use its machine in Schenectady, Smith was persuading the New York Telephone Co. to install telephone lines and teletype equipment. Their combined efforts cost them nothing but a little of their time.

The game the visitors played is called Nim. The students were seated so they could see the keyboard of the teletype on a television monitor. They "talked" to their electronic brain opponent in Schenectady on the teletype. The computer asked the student playing the game what move he had made and then told what move it, in turn, was making. It took the computer about a tenth of a second to make its move.

The game involved up to 12 chips. The number of chips to be used was determined by the toss of a pair of dice. The player must remove from one to three chips during his turn. Turns were taken until all the chips are gone. The player forced to take the last chip loses.

Although the untrained computer loses at first, it "learns" by its mistakes. After a number of games, it wins at least three out of four games. The machine "learns" by eliminating bad moves, and it never repeats a mistake. After a series of games with one visitor, the machine was stripped of its "memory" to allow another player to take part. While the games were designed for engineering students, visitors with other interests heard lectures, saw demonstrations and were taken on tours. All of Cornell's colleges, except Home Economics, were participating in the program.

Students attending Cornell Day were selected with the help of alumini. Some of the visitors were guests of fraternities and others were guests of Cornell freshmen in their dormitories. For many of the visitors the trip to Cornell cost

only a $5 registration fee. Alumini and the University picked up the tab in most of the cases.

Coordinator of the program was D. Harvey Krouse, associate director of admissions relations.

Public Library Computer System

Los Angeles Public Library
Los Angeles, California 90017

The first fully automated registration system for a major public library in America made its debut at the Los Angeles Public Library on May 23, 1966.

Records of more than 800,000 library users are being maintained by the City's IBM computers. Library users who live in the City of Los Angeles and who remain in good standing will not have to re-register every three years as they have in the past. This will be a permanent lifetime registration. Persons who obtain Library Cards on any other basis will have to qualify every year. The new system will reduce the cost of issuing Library Cards and maintaining registration files, and will provide a new series of controls over library usage.

"The new registration system is the beginning of a five-part program designed to improve the technical services which support the library," said Los Angeles Mayor [illegible]ty. "Our primary purpose is to make as many books available to as many people as possible. With our present budgetary limitations it is impossible to meet the demands being placed upon the public library by adults and children. It is, therefore, increasingly vital that we find ways of improving every aspect of the department which results in economies and efficiencies so that the flow of books can be increased."

The new registration system was put into operation with the mailing of 450,000 Library Cards. There will, however, be a period during the change-over when both the old and new cards are in use. Adults whose current cards expire in 1967 and 1968 received their new cards in the mail if they are in good standing, and if the Library had their correct address. Those whose cards expire in 1966 will have to re-register.

"Persons who have to re-register need not make any special effort to rush to the library," said Library Commission President Albert A. Le Vine. "Because of the great number of expected re-registrations it would be well to wait until your next regular visit to the library to re-register. There are no changes in the qualifications for receiving a Library Card."

Library Cards for young people were mailed only to those who have registered since September 1965. Anyone who applied for a Library Card as a "juvenile" or "intermediate" prior to September 1965 will have to re-register.

"One added feature of the new system will be the closer control over the issuance of Library Cards," said City Librarian Harold L. Hamill. "Cards will be mailed to the address listed on the application only. Persons giving false or incorrect addresses will not receive cards. This will help reduce the number of 'bad risks' who misuse the public library."

The new registration system is expected to help reduce the loss of library materials through negligence or willfulness. Persons who owe substantial debts to the Library will receive a notice asking them to settle their account before they can obtain a new Library Card. This is a closer control than has been possible under existing operations.

The Los Angeles Public Library's registration system is the first step in a five-part program that would make its technical services the most modern in America. The registration system is also the first automated program to be placed on the City [illegible] System/360 model 30, one of the [illegible] most modern computers.

The five-part program includes an automated ordering system to handle the more than one million dollars worth of books purchased each year; the ordering and controlling of more than 33,000 magazines and journals, some of them with as many as 100 subscriptions per title; cataloging of books with more than 17,000 different titles are processed each year; an improved circulation system with a faster and more accurate notification process for persons with overdue library materials and a more vigorous follow-up with delinquents.

"We will be able to maintain more accurate, up-to-date files on our books and patrons at a lower cost with the aid of computers," said Hamill. "We will reduce the number of books not returned to us which can be frustrating to other library users and expensive to the library."

Two years ago Stanford L. Optner & Associates was hired to make a study of the value of automatic data processing equipment in the Los Angeles Public Library. The study was set up to see if improvements in service and cost savings could be made within existing budget limitations.

"The Los Angeles Public Library is not about to become an automated library in the sense that machines will replace either books or librarians," said Optner. "We have dealt with areas in which immediate gains could be realized for a cost and service conscious administration. This study and program has nothing to do with information retrieval, a far more complex and difficult problem."

Hamill said the Library was able to enter the field of computerization only because of the recently developed Data Service Bureau operated by the City Controller. The Bureau handles a wide range of data processing chores for the city including the payrolls, cost reports, and accounting records. "Without this Bureau we could not begin to contemplate taking advantage of computers. The Library simply could not afford the initial outlay for computers and specialized personnel," said Hamill.

One new feature will be a list of delinquent library users to be maintained at each branch library and the Rufus B. von KleinSmid Central Library. This will eventually be integrated with the mailing of overdue notices to people who have not returned library materials on time. The circulation of nearly 14 million books a year to some 800,000 individuals has become such a huge operation that overdue notices have not been going out as regularly as they once did. The new program will get these notices out regularly and, hopefully, will prevent some people from accumulating excessive fines.

Hamill said the continuing growth of the Los Angeles Public Library has made it impossible to continue operating with old fashioned techniques. New economies and efficiencies must be introduced so that more money can be spent on books and magazines and other library materials. Hamill said it would be several years before the full benefits of automation would be felt. The registration system will operate as a separate unit until other systems are installed at which time they will be integrated to produce even greater benefits.

Installation of a computerized registration system for the Los Angeles Public Library has revealed some very shocking facts, according to Library Commission President Albert A. Le Vine. Initial estimates reveal that there is probably two million dollars owed to the Los Angeles Public Library by its users as of today, and that more than 134,000 books have been checked out and never returned.

"The institution of electronic data processing systems is tightening up our operations, and during the next couple of years there will be several steps taken to reduce the number of bad-risk library users," said Le Vine.

The startling facts came to light as the result of transferring records of registered library users from file cards to computer tapes. Information contained on the card files, that could not be compiled and analyzed due to the high cost and time involved, can now be analyzed quickly on the computer. Anyone who owed the Library five dollars or more was placed on a special report and will not receive a new Library Card until that debt is settled. There are 60,000 names on this special report, representing five years of accumulated debts.

The 60,000 library patrons with five-dollar debts, or more, are believed to have approximately 134,000 volumes in their possession. These are books checked out through normal procedures and not returned. The average cost of an adult book is five dollars, and the library collects fines only up to the price of the book. Thus, a person who has kept out a book that costs $7.50 would accumulate overdue fines up to $7.50. His total debt to the library would be $15 if he did not return the book.

"It must not be forgotten that it costs money to select, order, handle, catalog, and shelve new library books. These costs would amount to more than half a million dollars to replace 134,000 missing volumes," said Le Vine. "This says nothing of the frustration caused other library users who are not able to get the books they want and need.

"We currently take in about $600,000 annually in fines, but we are not interested in making money this way," said Le Vine. "Our business is making books available to people. When people owe these large fines they don't

books that are unreturned. We have no intention of allowing bad risks to continue using the Los Angeles Public Library."

If everyone paid their debts this week the Los Angeles Public Library would receive about two million dollars, or enough money to purchase 400,000 new books–which represents the complete collection at the five largest branch libraries in Los Angeles (West Valley, North Hollywood, West Los Angeles, Hollywood, and Van Nuys).

The Library does have one investigator working as a kind of bill collector. With more than 60,000 persons owing a minimum of five dollars and a city of 460 square miles, however, it is impossible for him to do anything by concentrate on the worst offenders. The Library's collector has even taken people to Small Claims Court on occasion.

Le Vine said the computerized registration system will prevent bad risks from getting new Library Cards whenever they are re-issued. Equally important, he noted that future developments in the electronic data processing systems design will place even tighter controls on overdue library patrons.

Other libraries have been investigating and using computer technology in recent years. It is Los Angeles' opinion, however, that the Public Library is the first to develop a fully integrated electronic data processing system. Each of the five elements described below can function independently; however, when integrated they will provide additional benefits. It is this aspect of a fully designed system that makes the Los Angeles Public Library's program unique:

• REGISTRATION. The Los Angeles Public Library has already launched a new registration system whereby the records of more than 800,000 library users will be maintained by computers. This aspect of the program will reduce operating costs, free much needed space in the Central Library, reduce the chance of error, improve the Library's ability to catch delinquents, and eliminate many of the bad risks.

• PURCHASING. The Los Angeles Public Library purchases approximately 62,000 book titles annually. The total number of books purchased is 267,000. The Library spends about $1 million a year on books and it costs more than $130,000 just to place the orders. A new and more modern system will be inaugurated later this year utilizing electronic data processing equipment. The new system will speed the placing of orders, reduce errors, increase discounts, improve delivery time, and improve the use of book purchasing funds.

• SERIALS. Magazines, journals, and other non-book materials published serially are a vital part of any library collection. More than 30,000 titles are purchased in quantities ranging from 1 to 100 copies. A modern computer system has been designed for installation later this year to maintain these important records and to check the status and location of publications constantly. As many as 2,000 serial publications are delivered to the Central Library daily.

• CATALOG. The cataloging of materials is one of the most important nerve centers of any library. It is through the catalog that people are able to find the material they need or want. About 17,000 titles are cataloged annually in the Los Angeles Public Library. Funds have been approved for system design and file conversion in the coming year.

• CIRCULATION. In 1949 the Los Angeles Public Library installed a photo-lending circulation system in which a picture was taken of the user's library card and a card from the book he was checking out. This was one of the first major libraries in America to install that process. At that time 7,800,000 books were circulated annually. Today the Library circulates about 14,000,000 books every year. Following the completion of the cataloging system, the Library plans to install a new circulation system during the fiscal year 1967-68. It is hoped that such a system will reduce the loss of books, improve the ability to catch delinquents, speed the mailing of overdue notices, and provide better statistics on Library usage. Increasing use of the public library is creating heavy demands on the present system.

FIDAC - Film Input to Digital Automatic Computer

National Biomedical Research Foundation
Silver Spring, Maryland 20901

The large-scale quantitative analysis of pictures cannot be approached by manual methods because of the tedium, manual precision, and extensive time that is necessarily involved.

Hence the National Biomedical Research Foundation has embarked on a program designed to enable the automatic analysis of pictures by means of a digital computer, with particular emphasis on pictures of biomedical importance, such as photomicrographs, electron micrographs, x-rays, and so forth. This capability of automatic quantitative analysis of pictures of biomedical importance promises to open up entirely new fields of investigation in biological and medical research which could not heretofore have been accomplished.

The task of quantitatively analyzing such pictures involved two steps: first, a scanning instrument called FIDAC was built which "reads" the picture into the high-speed memory of a digital computer; second, a computer programming system called FIDACSYS was written to recognize the object to be measured and to process the quantitative data as required by the particular biological or medical problem under consideration.

GENERAL CAPABILITIES

The name FIDAC stands for Film Input to Digital Automatic Computer. The instrument is fundamentally an input device to a high-speed digital computer. It enables a roll of film to be brought to the computer for input to the high-speed memory, just as a magnetic tape reel can now be brought to the magnetic tape unit for direct input into the computer's memory. The FIDAC instrument puts the pictures directly into the computer's (IBM 7094) memory within 0.3 of a second, with about 800,000 points per picture (1000 × 800 point raster) being sampled in the black-and-white mode, using one memory bit per picture point, or 350,000 points per picture (700 × 500 point raster) are sampled in the eight-level gray mode, using three memory bits per point (see Fig. 1). The number of points that are sampled per picture is presently limited, not by the FIDAC, but rather by the large-scale high-speed computer being used (i.e., core memory size). The FIDAC can resolve more than 1500 points across the width of the picture. The new generation computers, with higher speeds and larger memories, will be able to take further advantage of the capabilities of the FIDAC instrument.

Figure 2 illustrates the main components of FIDAC. The film-transport unit positions the film for reading. Film movement in the unit is directed by output signals from the computer, which are properly gated and transformed into control signals for the film-movement circuits.

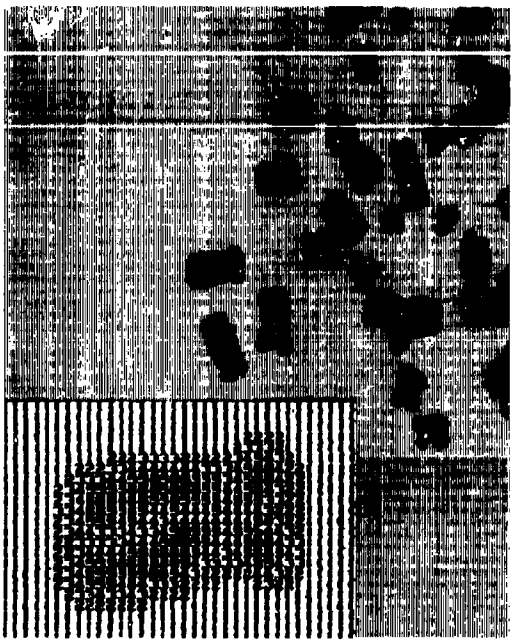

Figure 1 - Computer print-out of chromosome photomicrograph as read-in by the FIDAC, with detail inset

The deflection and pin-cushion-correcting coils, the coil driver, the focus and intensity controls, and the high-voltage supplies are associated with the cathode ray tube that produces the short-persistence 1.5-mil flying spot, with a maximum raster width of 10 cm. The fluorescence is focused by the optical system onto the film, which modulates the intensity of the light. The light then falls on the surface of the photomultiplier, which generates a video signal (the voltage divider and the power supplies are associated with the photocell). This video signal is amplified, sampled by the chopping signals, and sent through the level detectors. The resultant level signals are synchronized, and then are gated in the gray-level mode into the cyclic-encoding circuits to form a three-bit gray-level code for each sampled spot; in the binary black-and-white mode, only two gray levels are discriminated for a signal using only one bit per sample spot. The sampled information is received by the parallel-serial shift register, which buffers 36 bits (one IBM 7094 computer word) for input to the computer. It can be connected either for 12 three-bit parallel stages or for 36 single-bit serial stages, depending on whether the gray or the binary black-and-white mode is being used. The signals are "matched"

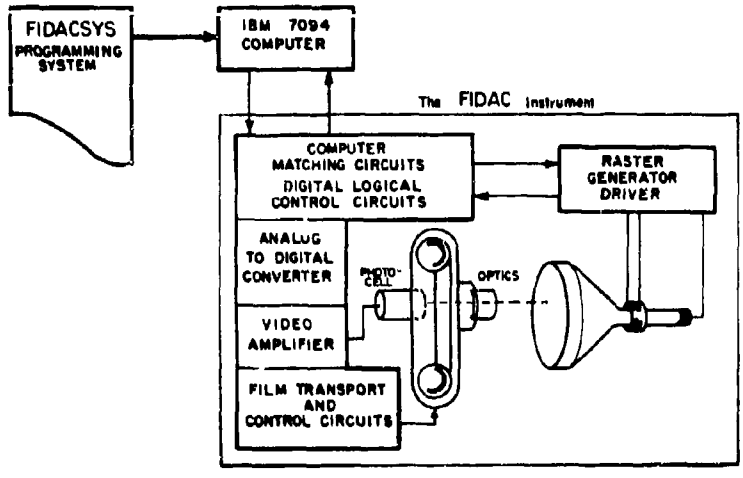

Figure 2 - Block diagram of FIDAC System

to the computer by the computer interface circuits. Synchronization is under the control of the master clock, clock-phase generators, and spot and word counters.

The amplified analog video signals from the photomultiplier are also fed to the monitor scope for visual display. The horizontal-and vertical-sweep signals are fed to both monitor and flying-spot scanner; and these are utilized as end-of-record and end-of-file signals (in the computer). Other control signals must be received from and sent to the computer for initiating the operation of the FIDAC upon its selection by the computer and for synchronizing and gating the input information to the computer.

THE FIDACSYS PROGRAMING SYSTEM

Once the picture is recorded in the computer's core memory as a grid of points, each with one of seven gray-level values (see Fig. 1), the computer analysis proceeds. The programing system FIDACSYS is designed to perform such analyses. This system consists of a large number of basic computer programs that are integrated with each other in different ways for different problems, as a general pattern-recognition-and-analysis language.

SUMMARY AND CONCLUSIONS

The successful design and application of the FIDAC instrument and the FIDACSYS programing system presents a new capability to the biomedical research scientist, opening new fields of investigation in the area of quantitative analysis of pictorial data of biomedical importance. The general capabilities of the FIDAC are those of a very-high-speed, high-resolution, on-line computer-input device, which can scan in real time with computer program feedback control. FIDAC was designed specifically for biomedical picture processing as follows:

1. For rapid processing of pictures for statistical analysis and screening purposes, it has a high-speed scan of less than 0.3 second per frame;

2. For retaining all information when scanning photomicrographs, it has a high resolution (greater than that of the optical microscope) where for 1000 X magnification each 0.2μ of the specimen is sampled by more than three points;*

3. For presenting the capability of program control by the computer, i.e., to move automatically to the next film frame when the processing of one film frame has been completed, it has real-time operation;

4. For extreme flexibility, convenience, and economy of storage of data, it is a direct

*About a 50μ field diameter on the specimen is seen at a magnification of 1000. The 750 points across the field give about 15 points per micron on the specimen or three points near 0.2μ, where 0.2μ is the optical resolution of a microscope at 1000 power.

input to the computer.† As a comparison, FIDAC can load the computer's core memory 10 to 50 times faster than can conventional magnetic-tape input units.

†The fact that FIDAC is on-line with the computer with no intermediate magnetic tape recording means that pictorial data on film can be used; a single 100-ft reel of 16-mm film which fits into a 3-1/2-inch diameter can contains 4000 frames and will record over 4 billion bits of information; this would require over 50 conventional digital magnetic-tape reels, making a stack of these reels over 4 feet high.

MAGIC - Graphic Display

National Bureau of Standards
Washington, D.C. 20234

MAGIC, an NBS computer system with unusual input-output capabilities, can place into its memory pictorial material which the human operator draws, assembles, and modifies on its screen. Pictorial material "drawn" on its screen is sensed and remembered by MAGIC (Machine for Automatic Graphics Interface to a Computer), a research tool developed at the National Bureau of Standards (U.S. Department of Commerce) in work co-supported by NBS and the National Aeronautics and Space Administration.[1] James A. Cunningham, Don E. Rippy, Donald E. Humphries, and Paul Meissner designed the machine for investigation directed at facilitating man's two-way communication with computers and the operation of remote computer inquiry stations.

MAGIC's operator draws on the screen of the display unit in somewhat the manner in which he would sketch a map for a fellow worker, with the assistance of computer operations for erasing, translating, rotating, adding additional information, and editing. The drawings created can be maps, plans, or schematic diagrams, for example. A completed drawing can be placed in the computer's memory and recalled for output or additional processing at a later time. This feature is of value for drawing routes on maps, charting courses, mapping weather predictions, keeping progress records, and maintaining up-to-date engineering drawings. Capable of operating as a self-sufficient computer, MAGIC can also be used with other computers as an input-output interface with the operator.

COMMUNICATING WITH COMPUTERS

Computers used in today's technology require that data and instructions be given them in a highly formalized language which must be learned by the machine users. Even devices enabling pictorial data to be read by the computer, for such purposes as automatic character recognition and performing biological and metallographic analyses,[2] impose some restrictions on data format.

The Bureau has long been concerned with reducing constraints of the man-computer interface. Computers that can accept data in a less restricted form will be useful to more people and for solving more types of problems. MAGIC does this by assisting its users in constructing graphic data and enabling these data to be inserted in the computer's memory in that form.

DESIGN OF MAGIC

MAGIC consists of a multisection, desk-type console forming a crescent before the operator. Visible to the operator seated at the console are a cathode ray tube (CRT) presenting the primary display, the "light pen" used with it, a secondary (passive) display, a keyboard input, and built-in and accessory control panels.

The basic principle of MAGIC is that a curve can be represented as a series of points along a connected path on the display area. Each point can be described in terms of the values of its Cartesian coordinates and numbers corresponding to its display characteristics. Thus a curve can be described by three parallel lists of numbers giving successive values for two coordinates and the display characteristics.

MAGIC is comprised functionally of a display unit, including both displays and the operator controls, and a processing unit, consisting

[1] D. E. Rippy and D. E. Humphries, "MAGIC-A Machine for Automatic Graphics Interface to a Computer," Proc. Fall Joint Computer Conference, 1965, pp. 819-830.

[2] Digital computer used for quantitative metallographic analyses, NBS Tech. News Bull. 47, 26-28 (Feb. 1963).

of a control processor and four subordinate list processors. Two of the list processors handle data forming the X field and the Y field, defining the trace path, and a third list processor supplies the display characteristics–pictorial or alphanumeric, gain, intensity, and whether point or line.

Part of the 90-channel magnetic drum memory serves the subordinate list processors. The drum's rotational speed of 1800 rpm provides a display refresh rate of 30 frames per second, sufficient to prevent flicker of a stationary CRT display. With a system clock rate of 54 kHz, 128 12-bit words are obtained per channel. Ten bits are used for each value in each field, making possible a display that is 1024 × 1024 discrete positions square.

Each of the identical X, Y, Z, and W list processors receives data from its drum channel and returns them to the write head for that channel. Operations performed on data flowing from the read to the write heads enable the operator to insert, delete, enlarge, reduce, shift horizontally, shift vertically, draw, add, and transfer blocks of data to and from general memory. These operations can be applied to points designated by the light pen, or to an entire figure.

MAGIC IN OPERATION

A presentation can be obtained on MAGIC's primary display in three ways: a previously memorized figure can be obtained from the machine's memory, the operator can draw a straight-line figure by means of the light pen, or a drawing can be assembled from components in the machine's "library" of symbols. In the last method the positioning operations are used to manipulate components and the light pen to connect them.

The operator can not only position material; he can also shrink, expand, and rotate it. When the drawing has been edited to the operator's satisfaction, it can be returned to the machine's memory. The digital information can be used to produce "hard" copy also; this has been done by placing it on magnetic tape to drive an X-Y plotter. This capability lends itself to making engineering changes on drawings and keeping up-to-date drawings on the tape for ready inspection and reproduction. It also permits making additions to maps, charts, or floor plans, a capability which should be useful in charting routes and courses, adding isobars and symbols to weather maps, and recording occupancy assignments.

MAGIC IN SYSTEM USE

MAGIC has recently been connected as part of a large automatic data processing system. This system consists of a MOBIDIC B twin computer and peripheral devices, including MAGIC. The system is being used in investigating time sharing, interfacing, and man-machine on-line techniques.

MAGIC is connected in the system by a voice-quality, half-duplex line limiting the data rate to 2.4 kHz. The rate could be much higher, except that it is desired to evaluate system operation for the voice-quality line, a practical and economic necessity for many remote-station applications. Display data in the system are stored locally and processed under direct user control at MAGIC, while MOBIDIC provides a large data base for storing graphic data and processing routines. By means of this interactive data processing the Center will be able to perform relatively complex graphic operations–curve fitting, geometric calculations, and graphical solutions to mathematical equations.

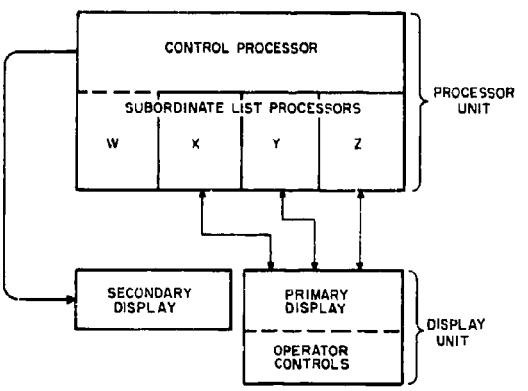

Figure 1 - MAGIC consists of a display unit and a processor unit. The subordinate list processors and their memory channels handle data giving the location and characteristics of points of the displayed material.

Figure 2 - NBS engineer Paul Meissner uses a light pen at MAGIC to connect an added symbol to a schematic drawing obtained from machine memory. MAGIC circuitry is contained in the console (background); operator sits in front of primary presentation and uses light pen, figures recalled from its memory, and keyboard input to assemble graphic data.

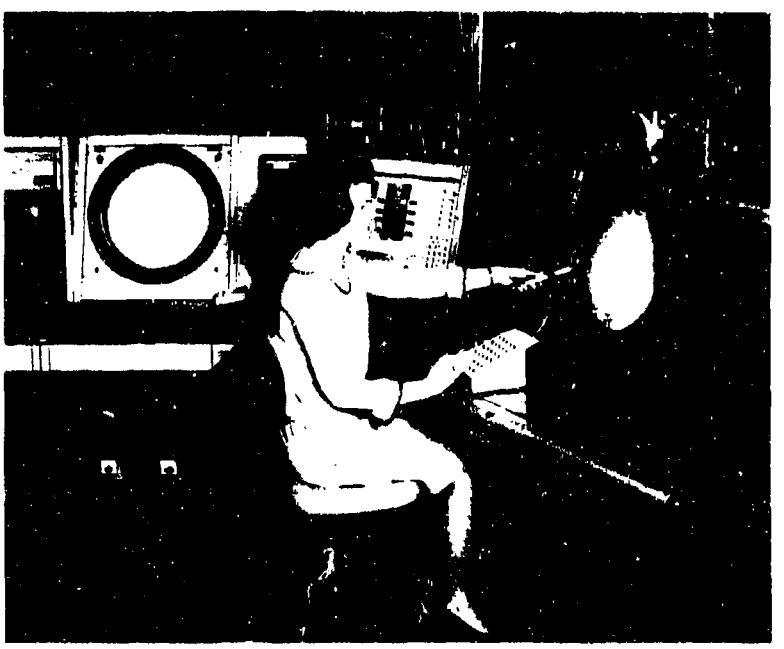

Figure 3 - Here the light pen is used to draw routes on a map obtained from machine memory. The control panel and keyboard input are visible beyond the operator; the cathode ray tube at the left is for a secondary presentation. The editing capabilities of MAGIC are useful for drawing weather and road maps and updating engineering drawings stored in the memory.

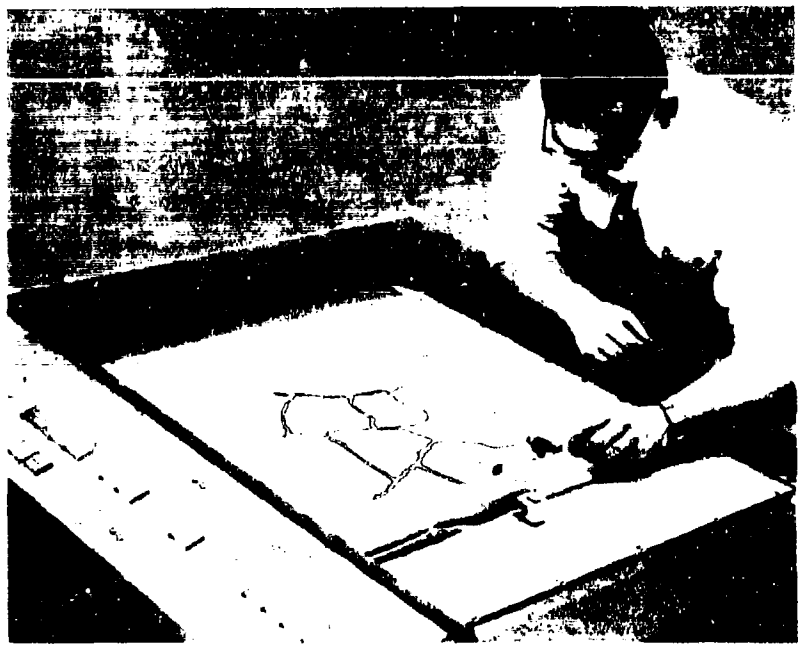

Figure 4 - Drawings made on MAGIC can be placed in the memory of a digital computer and used to control an X-Y plotter in reproducing them, as shown. This feature would be extremely useful in reproducing up-to-date versions of engineering drawings kept in a computer memory.

Oceanographic Data

Navy Electronics Laboratory
San Diego, California 92152

A full scale digital computer accompanied an oceanographic ship on a research expedition when the Navy Electronics Laboratory's USS MARYSVILLE left in June for an extended cruise to the Western Pacific. It is believed to be the first use for a major computer equipment on this kind of oceanic expedition. The ship will not return until October.

Reason for the computer is the rapidity with which data are gathered by the NEL (temperature measuring) Thermistor Chain. The computer is a standard Univac 1218 adapted slightly for shipboard installation and is capable of handling output of one data word every 0.3 seconds continuously.

Five NEL chief scientists are supervising the various sections of the expedition. They are, Dr. E. C. LaFond, head of the NEL Marine Environment Division which has scheduled the cruise; Edward L. Smith; Dale E. Good; Dr. P. G. Hansen; and Owen S. Lee. There are seven sections to the expedition. The first, from San Diego to Hawaii, is under the direction of Good.

The main purpose of the expedition is to investigate factors that pertain to underwater sound, convoy, and submarine operations. Interest in the cruise is enhanced by the current international situation.

A second consideration is the Pacific Science Congress which was held in Tokyo August 20 to September 2 at which time open house was held on board the USS MARYSVILLE.

The main tool to be used on the cruise is the Thermistor Chain. This NEL device mounted in the ship's stern, reaches down to a depth of

nearly 800 feet and records the temperature in such a manner that isotherms are plotted continuously so that depth as the ship progresses.

Specific objectives of the expedition are to:

1. Record temperature in analog and digital form and compute horizontal and vertical gradients.

2. Measure surface and sub-surface currents. (Four recording current meters are mounted at equal intervals on the Thermistor Chain.) Because water motion causes a certain amount of heat exchange at boundaries, the data gathered will help to explain the thermal structure, and provide a basis for estimating the vertical shear of the boundary.

3. Record echo sounder data on the distribution of scattering organisms. Inhomogeneities in the ocean lead to sound scattering which removes sound energy from the main sonar beam. The Navy Electronics Laboratory has an extensive program of classification of echoes from marine organisms. These gas-filled organisms are efficient scatterers of sound energy and play a big part in study of the deep scattering layer.

4. Regular bathythermograph lowerings will be made at regular intervals.

5. Bottom soundings will be made in areas where submarine canyons are of particular interest and at other areas of opportunity.

There are a number of areas of special interest to scientists on the expedition. One is the boundary region between the Eastern North Pacific Central Water and Transition Water. This area lies roughly half-way between the California Coast and Hawaii, and is of special concern to Dale E. Good, Chief Scientist for this phase of the expedition.

A second area of prime interest is large thermocline dome S.W. of Hawaii. This dome was discovered by the MARYSVILLE using the thermistor chain in 1964. Edward L. Smith, Chief Scientist is seeking more information concerning the possible cause of this phenomenon.

A third special interest area is near the transition from Equatorial Water to the large North Pacific Central Water Mass between Hawaii and Midway. No data currently exists on this area.

A fourth area–one of intense interest–is the meeting of the Western-North Pacific Central Water and the Kuroshio Countercurrent. Strong horizontal gradients exist in the Kuroshio system and the thermal structure is further complicated by meandering with subsequent formation of large horizontal eddies. This is the first crossing by a thermistor chain of a western boundary current in the Pacific. Temperatures, current, biological scatterers, and bottom structure are being recorded in this unknown area. Dr. Polk G. Hansen is Chief Scientist for these mid-Pacific studies.

The huge eddy formed south of Honshu Island, and located between the main island and the Kuroshio Current causes a large dome in the thermocline which is a fifth area of interest. Japanese hydrographic data indicate that the eddy mysteriously forms and disappears with a period of about 10 years. Owen S. Lee, Chief Scientist for this phase of the cruise, who is the leading authority on internal wave structures, and also the program manager for physical oceanography at NEL, is hoping for some additional information on this area.

The Tsushima Current is the sixth ocean center of attraction for Expedition scientists. Here warm saline water from the Kuroshio Current flows along the west coast of Japan where it meets the Tsushima Current causing an oceanic frontal system. This system in the waters between Japan and Korea is unique and a gainful study of it is anticipated by the NEL oceanographer Edward L. Smith who is the Chief Scientist for this operation.

The seventh area of interest is the area where the Kuroshio Current turns seaward and becomes the Kuroshio Extension. It is here that it converges with the Oyashio Current. Many eddy formations are formed here which are of interest to the NEL oceanographers. Mr. Smith, Chief Scientist for the cruise is in charge of effort in this area also.

On the return from Hawaii, the boundary area between the Eastern North Pacific Central Water, and the Transition Water will again be traversed with an established pattern to investigate the north-south axis for the first time. Dr. E.C. LaFond, Head of the Marine Environment Division at NEL will supervise this section of the cruise personally.

The USS MARYSVILLE is one of two sister ships used extensively by NEL for expeditions such as this. She is commanded by Lieutenant C. E. Clese, Jr., USN, and has a complement of 6 officers and 65 men.

Records Automation

New York State Department of Motor Vehicles
Albany, New York

More than an acre of conventional filing equipment belonging to the New York State Department of Motor Vehicles will be eliminated under a new, advanced computer system announced in April by Motor Vehicle Commissioner William S. Hults.

The Commissioner said, the new equipment will "reshape the Department's operations for a whole generation." When fully installed, annual savings of some $850,000 will result, primarily in entrance grade salaries for the cost of maintaining old-fashioned paper files, the Commissioner explained.

IBM was the lowest of four bidders able to demonstrate its equipment. Proposals were evaluated under a complex formula, and the successful bid involves an extended purchase option at a total cost to the Department of about $90,000 a month. Under this plan, the Department would own the basic equipment outright in 7 years. The $90,000 includes the basic computer, leased communications lines, field terminal devices, and peripheral equipment.

The system's first units were scheduled for delivery about October 1, 1966, and the final components will be added by October 1968. The system is designed so that as computer technology improves, obsolete units can be replaced with new ones without disrupting the basic configuration.

The system will be the largest and most advanced motor vehicle system of its type in the world, stated Commissioner Hults. It embodies three concepts not available in the Department's computer. These include:

IMMEDIATE ACCESS

Most motor vehicle records, at present, are stored on magnetic tape. If a particular item of information is sought from this tape, a punch card must be prepared and fed into the computer configuration. It requires 2 days to run the complete tape through the computer. When the item being sought is reached on the tape run, the computer responds to the inquiry and prints the answer. Thus, if the item happens to be near the end of the tape, run, it can take up to 48 hours to obtain an answer.

Since some motor vehicle data is needed immediately by police, it has been necessary to maintain parallel paper and semi-conventional microfilm files which cover more than an acre in two buildings in Albany and which require about 1.6 million dollars annually to maintain.

The new computer system, instead of storing data on tape, will store it in tiny electronic "memory cells." When an inquiry is fed into the computer, the memory cell responds almost instantaneously with the desired information.

This system will thus provide immediate access to information on some 8 million drivers, 6 million vehicles, an estimated 4-1/2 million traffic convictions, 6 million insurance policies, 1 million traffic accidents, and a variety of other motor vehicle records. Thus the conventional files can be abandoned. The source documents themselves will be retained in a far less expensive "batch filing" operation for reference when needed.

TELECOMMUNICATIONS

At present, anyone wishing information from motor vehicle files in Albany must write, telegraph, or telephone the Department. A Department employee, receiving the information, must either check the conventional files manually, or prepare a punch card for entry in the computer.

Under the new system, some 216 "inquiry stations" will be installed throughout the state in motor vehicle offices. These stations will be connected directly with the central computer in Albany. Thus an inquiry entered on a station in, for instance, Syracuse, will feed directly into the Albany computer and an answer will be flashed back and printed within seconds at the Syracuse station.

DAILY UPDATE

At present, business in Motor Vehicle field offices sometimes takes days to reach the Department's central files in Albany, since it must undergo office processing, shipping to Albany, auditing, and manual filing.

Under the new system, local offices will feed most of the day's transactions directly into the computer that day. Thus if someone registers a new car on Monday, the Department's central office records will show this registration and plate number that same day.

The Commissioner cited the following additional advantages to the new system:

- It will enable the Department of Motor Vehicles to absorb an estimated annual half million increase in vehicles registered and drivers licensed without adding employees in these programs each year.

- It will expedite the issuance of licenses and registrations in the field, eliminating many time-consuming letters to Albany. Service to the public will thus be improved substantially.

Specifications for the system were developed by a committee of Department specialists headed by Bernard J. Lynch, Director of Central Office Operations. Another committee under Mr. Lynch's direction is now working on plans for conversion of the present motor vehicle operations to the new computer over a 2-year period.

Commissioner Hults cited achievements of the Department during the last 6 years which have led to conversion to data processing of programs in drive licensing, driver improvement, accident records, and most recently, vehicle registration.

"With the conversion of the registration program this year and installation of the new computer configuration by 1968, most of our plans for modernizing what had been a creaky anachronism of state government will have been completed," the Commissioner said.

Computer Use Efficiency Study

New York University
New York, New York 10003

How can computer services be made more efficient, more extensive, more accessible, and less expensive for students and professors in a campus environment?

New York University has launched a 3-year research program to find answers to these questions.

In two related studies, the researchers will seek better ways to link a small satellite computer with a large central computer and methods of equipping relatively small computers for student use with some of the speed, efficiency, and advanced capabilities now available only in large, expensive systems.

A third project is concerned with developing computer-aided proofreading and data manipulation techniques adequate to handle the technical problems and masses of data encountered in humanities research.

An IBM System/360 Model 30 computer in the Heights Academic Computing Facilities (HACF) at the University Heights campus in the Bronx will be linked with one of two larger systems at NYU's Washington Square Center in Manhattan. The IBM Corporation will assist the NYU investigation by providing special technical support and assistance.

Research will be directed by Dr. Jack Heiler, professor of mathematics and director of the HACF. The HACF itself, a computing center specifically for students, will be used as a test subject in the first two projects for experiments toward improving computing techniques and capabilities for relatively small student-service operations.

The first project is designed to define and develop the role of a small, satellite computer linked both with several remote typewriter terminals and a large central computer. The goal is to develop a system that will automatically share and balance the work load between the computers for maximum efficiency.

NYU researchers will develop and test various experimental load-balancing and time-sharing techniques in an effort to give the University Heights computer the automatic capability to sort and share with the Manhattan computer work coming in from a number of remote terminals in departmental offices.

"If successful," Professor Heller said, "the project will increase the value of relatively small computers by increasing their effective capability. This will be a boon to schools and other users unable to afford larger systems or whose work doesn't justify their size and expense."

In addition, it will save users time, he said. Instead of going to the large central computer, they can work from their own offices or at a nearby small machine and still enjoy the computing capabilities of the large central machine.

In the second, related project, Professor Heller said that the researchers will attempt to equip a relatively small computer with a time-sharing capability for student use. Time-sharing systems that allow a number of persons to use a computer at the same time, he explained, now require large machines that are too expensive for many colleges.

The system will be designed to allow students to gain fast, efficient computer service through any one of several scattered typewriter terminals. The researchers hope to achieve a system that will automatically notify the user of any mistakes in his computer instructions so that they can be corrected immediately.

Ordinarily, Professor Heller said, students drop problems off at the HACF and return later for the results. If there were mistakes in the computer instructions, however, they find rejected problems that must be corrected and submitted a second time.

An efficient time-sharing system with remote terminals will eliminate this delay and also will allow more students to use the computing services. In addition, results will be automatically typed out on the typewriter terminals, eliminating the need for trips to the computing center. Work on this project will include the adaptation of FORTRAN computer language to the needs of the projected system.

Professor Heller said that the HACF now handles some 300 problems a day from students in the School of Engineering and Science and University College, the two colleges at the University Heights campus. Night and weekend time is taken up by graduate and special students with longer problems and by some non-supported faculty research.

"Within the next few years," he added, "usage is expected to jump to 1,500 student problems a day." For this reason, he explained, the Heights campus is an ideal place to develop and test student computing systems in a "true academic environment."

In return, he said, the campus will gain a low-cost, time-sharing computer system and students will enjoy increased computing capacity and speed plus the opportunity to gain experience and training in time-sharing techniques.

The proofreading project was prompted by the fact that the masses of data generated in computer research in the humanities demand more efficient data-handling and manipulation techniques. Studies in literature and in languages, for example, involve problems such as the compilation of a concordance for a writer's entire works, the indexing of all issues of scholarly periodicals, or the word-by-word insertion of an entire novel into a computer for analyses of style and word usage. Some of these problems require more than 100,000 data cards.

"What we need," Professor Heller said, "are more automatic and computer assisted methods for correcting, re-arranging, adding and deleting information from this stored data. Currently, making changes can mean that several filing cabinets full of cards must be run through the computer again." For the answers to these problems, the researchers will experiment with ways of getting information in and out of large, direct access storage units, called disk files.

"We already have developed SYMAN (for symbol manipulating), a new computer language to facilitate the manipulation of strings of characters and lists of words and sentences, the breaking of paragraphs into sentences, sentences into words, and the reverse formation of words into sentences and paragraphs," he said. "We expect results from this project to enable scholars in the humanities to tackle research problems that we now know how to do but can't do because the volume of data involved makes them impractical," Professor Heller said.

New Graduate Program in Information Sciences

Ohio State University
Columbus, Ohio 43210

Ohio State University began a new graduate program in information sciences this fall which is being directed by a man who formerly headed the Naval Analysis Group in the Office of Naval Research, Washington, D.C.

Dr. Marshall C. Yovits, 43, was appointed professor and chairman of the Division of Information Sciences in the Graduate School and director of the Center for Research in Information Sciences. Both are being established under his direction.

Dr. Jackson W. Riddle, associate dean of faculties, said that Battelle Memorial Institute and Chemical Abstracts Service, both university neighbors, will cooperate in development and actual operation of the graduate program.

Riddle added that the National Science Foundation has been asked for financial assistance in developing the program.

Dr. Yovits, who has been with Naval Research since 1956 and developed its Information Systems Branch, said this is a rapidly expanding field in which more and more universities are establishing programs.

Where most other institutions stress a particular area of information sciences, Ohio State's program will be distinguished by its breadth. Information sciences deal with the collection, storage, retrieval, processing, utilization, and prediction of information.

Also involved are any techniques and equipment necessary to perform these operations. Information is defined as data of value in decision making.

As an inter-disciplinary program, it will involve such areas as mathematics, psychology, biology, engineering, physics, linguistics, logic, computer sciences, and systems sciences, Yovits said.

Typical areas of information sciences that will be covered are computing circuits and logic, self-organization and adaptive systems, pattern and speech recognition, programing, and information and communication theory.

Yovits is presently involved in the recruiting of students and assembling of staff as well as program development. Housing will have to be rented for the first year.

Battelle and Chemical Abstracts will cooperate both in providing staff members on a part-time instructional basis and in research. Some of their facilities probably will be made available to Ohio State, Riddle said.

This cooperation plus the challenge of establishing and running a new program are what brought Yovits to Ohio State, he said. Emphasis of the program will be to turn out teachers of information sciences, researchers, and individuals who can solve operational problems involving these sciences.

Yovits, born in Brooklyn, took his early college work at Union College in Schenectady, and then went to Yale for his master of science and Ph. D. degrees.

He was a physics instructor at Union and Yale while working on his advanced degrees and then became senior physicist in the Applied Physics Laboratory at Johns Hopkins University. In 1956, he went with the Office of Naval Research as a physicist in the electronics branch, and within a year was appointed Head of the new Information Systems Branch.

Riddle described Yovits as one of the leading figures in the information sciences field.

He is married, and the couple has three children.

Shared Central Accounting System

Parsons College
Fairfield, Iowa

Parsons College, one of the nation's fastest growing educational institutions, announced in April plans to computerize its entire central accounting systems and that of two other Midwest colleges also.

Dr. Millard G. Roberts, Parsons president, said a System/360 Model 30 will be installed to provide fast, economical administrative and academic services on a shared-time basis for Parsons, Midwestern College in Denison, Iowa, and Hiram Scott College of Scottsbluff, Neb.

Remote terminals at Midwestern and Hiram Scott already link them to data processing machines on the Parsons campus. Conversion from the present equipment to the System/360 will provide instantaneous processing of nearly all college administrative tasks.

"When completed," Dr. Roberts said, "the System/360 will free academic and administrative personnel on three campuses from the burden of manual record keeping on admissions, room assignments, student scheduling, grade reporting, test analyses and transcript preparation. The equipment will also be used, either on site or from remote terminals, for data processing coursework and research."

Dr. Roberts said: "We view the addition of the System/360 as a further step in our program of expansion and investment which thus far has brought our college's financial condition from a deficit to a surplus; has increased enrollment nearly 20 times its 1955 level; and has increased average faculty salary from $3,600 to nearly $14,400.

Parsons president attributed the college's success to the application of business principles to the field of college management—including paring low-registration courses from the curriculum, adoption of a year-round Trimester system, team-teaching, an ungraded curriculum which permits a student to move at his own pace, and a new construction program.

"By pooling our resources and sharing the System/360 capacity," Dr. Roberts said, "we will be doing what many businessmen already do—gaining maximum technological benefit from a minimum outlay of resources.

Menu-Planning by Computer

Tulane University
New Orleans, Louisiana 70118

Sara Mayo Hospital, a small hospital for women and children in New Orleans, in May became the world's first hospital to use a computer full-time to plan its menus.

The time- and money-saving computer program (now being used by Sara Mayo) is the product of 4 years of research by a Tulane University computer research team directed by Dr. Joseph L. Balintfy, associate professor of operations research in the Tulane School of Business Administration.

The Tulane system applies advanced mathematical techniques and an IBM computer to the problems of menu-planning so that "a hospital now can save up to 24 percent of its raw food costs with simultaneous improvement in the quality of food service and patient care," Dr. Balintfy said. "Such results would have been impossible 10 years ago—before high-speed computers were commonly accessible."

Computer instructions developed by the Tulane specialists enable their electronic data processing equipment to print varied daily menus. Each menu meets nutritional and other requirements at the lowest possible cost per patient.

The research project involved two phases. The current phase, financed by a 3-year $242,600 grant from the National Institutes of Health, began in 1964. Its objective was to establish an experimental central computer system to plan daily menus for hospital patients in three New Orleans hospitals and at the University of Missouri Medical Center.

New Orleans hospitals cooperating in the research are Sara Mayo, the U.S. Public Health Service Hospital, and West Jefferson General Hospital.

A separate research team was stationed at the University of Missouri under the direction of Dr. Aimee N. Moore, co-principal investigator.

An IBM 7044 computer system at the Tulane Computer Center was modified to provide for remote terminals linking Sara Mayo and the other two hospitals and the University of Missouri Medical Center. Through these IBM 1050 data transmission terminals, information was entered into and menus retrieved from the 7044.

In Dr. Balintfy's approach, menu-planning problems at Sara Mayo (or at any other hospital) were identified and formulated into linear programming problems.

A complete dietary information system, the first of its kind, was designed to feed pertinent data into the mathematical model. The system is adaptable to the needs of any hospital in organizing and collecting information.

Three major kinds of data were placed in the computer's memory file.

First was the content of 19 different nutrients for each of 2,500 foods which could be contained in hospitals' recipes. A highly complex program computes from this data the nutrient content per serving for each menu item.

Second item of information to be developed in quantity was the popularity of menu items on each hospital's protected recipe list and the frequency of request of the items.

Third, the recipe file was entered. From it, cost-per-serving and the nutrient content of each dish were calculated by the computer.

At Sara Mayo, 400 recipes were stored in the computer's disk files. In the case of the USPHS Hospital, which has a more complex menu, there were 750.

How does the system work for Sara Mayo?

From the hospital's data input, the special mathematical program developed by the Tulane specialists computes and prints out in seconds a menu for each day. The menu fulfills all nutritional allowances specified by the hospital—or by a particular diet—at lowest possible cost per patient.

Sara Mayo's dietician sits at an IBM 1050 remote terminal in her office, enters nutritional specifications and may change items for a particular meal. The rest of the menu is automatically adjusted by the computer to meet nutrient requirements. Hospital food service personnel periodically updates food costs according to market fluctuations so that the computer menus will reflect seasonal differences.

During the Sara Mayo experiments, the Tulane researchers made a month-long comparison in which a set of menus was planned without computer aid and a set with the computer's help. Both had identical feeding goals for regular diets.

Without computer planning, Sara Mayo spent $1.36 a patient a day for food. With the computer's help, the cost would have been $1.04—a savings of 32 cents per patient per day. This finding and others in the comparison will be included in a research paper soon to be published.

Although menu-planning by computer now is fully operational at Sara Mayo, the USPHS Hospital's program will not be in full operation until sometime in June. West Jefferson Hospital's program is scheduled for operation later in the year. Dr. Balintfy explained the more complex menu structures in both hospitals require longer preparation before full implementation can take place.

First phase of the Balintfy team research was done at Touro Infirmary, New Orleans, from 1962 to 1964. In this phase, data was collected only once, and continuous updating of data was ignored.

The system was refined, however, so that the computer could print daily menus in less than 40 seconds. Carefully controlled experiments proved dieticians are willing to accept the computer menus, as well as the computer, as their tool. The results of this pilot study were published in several journals in 1964 and there still remains a heavy demand for copies.

The research also generated a companion educational arrangement. On March 7, the Balintfy team's menu-planning program was used in a unique, cooperative venture between the Ohio State University College of Medicine and the Tulane Computer Center.

Twenty-five OSU medical dietetics students prepared, in advance, information required by the computer. It was fed into an IBM 1050 terminal connected by long-distance line to the Tulane 7044. To start the project, the computer number was dialed direct over Bell System Dataphone. The students received computer-planned menus and used them to study menu-planning, food costs, and nutrition.

Similar operations are scheduled for students at St. Mary's Dominican College in New Orleans, and University of Missouri students.

Another educational benefit of the program is the offering of research fellowships in connection with Tulane's new doctoral program in management science. They are designed to develop a core of experts for the applications and furthering of the scientific method and computer models in the area of institution management.

Efforts of the Balintfy team now will be directed toward implementing and testing of more advanced computer programs for selective menus and modified diets. The team also will work on possible application of the already developed techniques to other non-selective volume menu areas such as schools, detention and nursing homes, colleges and universities, and the armed forces.

COMPARATIVE COST AND NUTRIENT STATISTICS

	Food Cost Per Patient Per Day	Nutrient Content of Menu								
		Cal.	Prot. (gm)	Calc. (mg)	Iron (mg)	Vit. A (I.U.)	Thia. (mg)	Ribo. (mg)	Niac. (mg)	Vit. C (mg)
Hospital Menu Served in October	$1.36	3029.	112.3	1257.	18.4	15656.	1.65	2.61	22.3	149.
Menus Planned by Computer for October	$1.04[a]	2531.	95.2	1123.	16.0	17487.	1.40	2.44	19.9	118.
April Menu Based on Computer Plan[b]	$1.05	2691.	98.2	1163.	16.8	18592.	1.44	2.62	20.7	118.
Menu Planned by Computer for May[c]	$1.07	2500.	93.0	800.+	16.0	5000.+	1.41	2.39	19.7	70.+

[a] The food cost includes the cost of two glasses of milk per day. The computer can satisfy all nutrients with one glass of milk per day at a food cost per patient per day of 97¢.

[b] 91% of the menu items in this menu appear in the computer menu plan for October.

[c] 90% of the menu items in this menu appear in the computer menu plan for October.

RECIPE DATA SHEET (RDS) . . . . . MASTER RECIPE INFORMATION

1 Card 6 Column	7 44	45	46-47	48-51	52-56	57-61	62-65	66	67	68	69	70-72	73-74	75-77	78-79	80
Recipe Code Number	Recipe Name and Alternate Recipe Name Please Print	Alternate Recipe Code	Total Number of Ingredients	Number of Servings	Estimated Size of Serving Volume (Ounces)	Estimated Size of Serving Weight (Ounces)	Total Cooked Recipe Yield in Pounds	Dominant Color Code	Flavor Code	Texture Code	Temperature Code	Appropriate Course Code	Separation Rating (Mean)	Blank	Hospital Code Number	Card Code
360015	Fiesta Rice		08	0125		4	32	2	2	2	1	404	23		03	2

*Optical data

RECIPE DATA SHEET (RDS) . . . . . INGREDIENT INFORMATION

*	*	*	*							*				
1 Card 6 Column	7 – 12	13 – 39	40-43	44-48	49-54	55-57	58-60	61-63	64-66	67-69	70-75	76-77	78-79	80
Recipe Code Number	Food Code Number	Ingredient Name, Also (Substitute Ingredient Name Usable By-Product Name) Please Print	Nutrient Code Number	Amount of Ingredient Used in Recipe		Conversion Factor Code No.	Pre-preparation Yield %	Preparation Yield %	Cooking Yield %	Edible Portion Yield %	Substitute Food Code Number	Blank	Hospital Code No.	Card Code
				Quantity	Unit of Measure									
360015	300470	Rice, Minute	1874	5.	lb.	001	100	100	320	100			03	3
360015	120090	Oleo, Salted	1317	2.	lb.	001	100	100	100	100			03	3
360015	800970	Tomatoes, Whole	2284	2.	#10 can	131	100	100	075	100			03	3
360015	800415	Green Pepper, Chopped	1546	1.	lb.	001	082	100	092	100			03	3
360015	990120	Salt, Iodized	1963	0.5	cup	103	100	100	100	100			03	3
360015	980130	Pepper, White	0000	0.25	cup	103	100	100	100	100			03	3
360015	000000	Water	0000	3.	qt.	101	100	100	000	100			03	3
360015	220208	Olives, Ripe	1409	1.	#10 can	131	100	100	100	100			03	3

Card Code 3 – Ingredient Name Card Code 4 – Substitute Ingredient Name Card Code 5 – Usable By-Product Name *Optional Data
Card Code 6 – Sub-Assembly Card Code 8 – Substitute Sub-Assembly

Recreational Areas Inventory

U.S. Department of the Interior
Washington, D.C.

The Bureau of Outdoor Recreation, Department of the Interior, is responsible for formulating an outdoor recreation plan for the nation and for updating it every five years. The Center for Computer Sciences and Technology, in the Institute for Applied Technology, National Bureau of Standards, has developed a data system in support of this responsibility. An inventory of existing and potential recreational areas in the United States provided information to form the basis for a mechanized file. This data base has been established for all non-urban areas and for selected cities.

The data have been collected in various tabular forms and supplied to interested state and local authorities. The data base will provide an information source for further processing, after refinements and corrections have been made to it.